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Ascidiacea (Tunicata) in Australian waters of the Timor and Arafura Seas

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ABSTRACT

Fifty-seven species of Ascidiacea from Australian territories bounded by the Timor and Arafura Seas are discussed. The majority were known previously from western Pacific and/or Indian Ocean (including Australian) tropical waters, although 13 species are new. Discussions focus on geographic range and/or morphology of adults and larvae and their relationships. New records for a further 37 known species are listed. The majority (35) of species discussed, including 11 that are new (seven in the genus *Didemnum*, three in *Polysyncraton* and one in *Trididemnum*), are in the family Didemnidae. *Trididemnum pseudodiplosoma* (Kott, 1962), an indigenous species originally known from southern Australia, is recorded again from the Northern Territory. *Diplosoma ferrugeum* Kott, 2001 is proposed as a junior synonym of *D. versicolor* Monniot, 1994. Non-didemnid aplousobranch taxa, Polycitoridae, Holozoidae and Polyclinidae are represented, respectively, by *Eudistoma* spp. including the unusual *E. ovatum* Herdman, 1886 (which is redescribed); *Distaplia* spp. including a new, possibly tropical sister species of the temperate *D. australiensis* Brewin, 1953; and *Polyclinum* spp. including the tropical *Polyclinum tsutsuii* Tokioka, 1954 (also redescribed, together with its incubatory pouch). In other suborders, a multipapillate larva is described for *Perophora modificata* Kott; 1985 (Phlebobranchia); and tropical and sub-tropical species of the colonial styelid genus *Symplegma* (Stolidobranchia), including a new Australian species, are redefined and a key to their identification presented.

KEYWORDS: brood pouch, multipapillate larva, siphonal armature, new species, Ashmore Reef, Darwin, *Perophora, Distaplia, Polyclinum, Leptoclinides, Polysyncraton, Didemnum, Trididemnum, Lissoclinum, Diplosoma, Symplegma.*

INTRODUCTION

This report is based primarily on SCUBA collections from the Darwin region and Ashmore Reef, at depths from four to seven metres. The material from Darwin supplements that reported on by Kott (2002), but the collections from Ashmore Reef represent the first significant sampling of ascidians from this location. Although an Australian Territory, Ashmore Reef, in the Timor Sea (between 122° 53' and 123° 16'E and 12° 10' and 12°20'S), is well separated geographically from the north-western Australian coast and considerably to the west of Darwin and the Northern Territory (Fig. 1). The area is in the path of south-flowing currents from the Malaysian peninsula, Indonesia and the Philippines and its marine assemblages appear to form part of a chain of recruitment and a pathway for gene flow between Australia and that part of the tropical Indo-west Pacific to the north. The majority of the species recorded in the present work are tropical ones and more than half (35) of the 57 species discussed have been recorded previously from the western Pacific and/or Indian Ocean, including Australian locations. In due course, the 13 new species may be found to have a similar range. The relatively restricted known range across the north of Australia of the six species of the family Polycitoridae recorded here may also be the result of lack of records. It is apparent that northern Australia is not isolated from the Indo-west Pacific tropical region and must be considered part of it. Some isolation of tropical from temperate fauna is evident around the southern half of the Australian continent in the existence of indigenous as well as Southern Ocean species (Kott 1985, 1990, 1992, 2001) and in the southern limits of the range of many tropical species about halfway down the eastern and western coasts of the continent. Evidence of a tropical affinity for an appreciable proportion of Australia's indigenous ascidian species as well as the separation of temperate from tropical fauna exists in the possibility that tropical *Distaplia turboensis* sp. nov. is a sister species of the temperate *D. australiensis* Brewin, 1953 (see below). Nevertheless, in some cases, some gene flow appears to ensure a continuous range between tropical and temperate waters for species such as *Trididemnum pseudodiplosoma* (Kott 1962) and many others (see Kott 1985).

It should be noted that the material on which this report is based is from general invertebrate collections, yet the dominance of the family Didemnidae is striking. This may be partly the result of subjective collecting bias, the habitats and depth sampled and the size and conspicuous

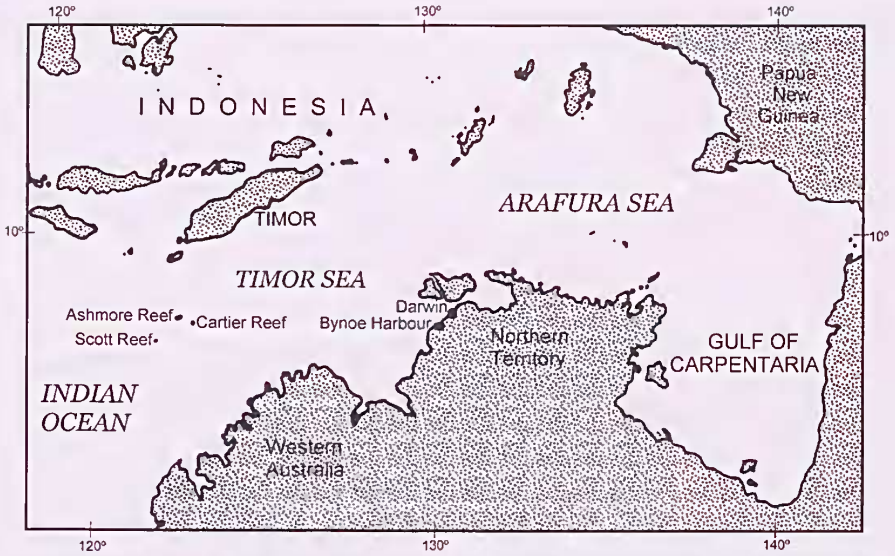

Fig. 1. Map showing the Arafura and Timor Seas and their relationship to the Australian mainland and Papua New Guinea and Timor (collecting areas indicated).

appearance of didemnid colonies. Undoubtedly it also reflects a diversity of the family Didemnidae in shallow water locations and may reflect the advantages of sheet-like colonies with two-dimensional growth patterns that rapidly occupy space.

The genus *Symplegma*, a colonial stolidobranch genus with a similar two-dimensional growth form, is also relatively well represented in these waters by four of the seven tropical species known worldwide. As in the Didemnidae, size reduction and simplification, associated with replication, mask possible diagnostic characters in this genus where intra-specific variations are not well documented and species parameters not well defined, resulting in a tendency either to regard specimens from a wide geographic range as conspecific (resulting in a number of apparently pantropical species (see Kott 1985)) or the acceptance of every variation as a species character (resulting in confusing synonymies; see C. and F. Monniot 1997 and Monniot 1988). The genus, being colonial, broods its embryos and it is unlikely that larvae have long free-swimming lives, a factor that tends to support radiation and speciation. Indeed many species do appear to have a relatively limited range, but others do not. As shown in the key to species (below), those with entire (unlobed) testis follicles (readily distinguished from others with lobed and/or branched follicles) are recorded only from a limited geographic range. These species are *S. viride* (Herdman, 1886), well known from the western Atlantic, *S. reptans* Oka, 1927 from Japan and southern California (from 1995: see C. and G. Lambert 2003), *S. zebra* Monniot, 2002, from Mozambique and the Maldives and *S. teruakii* sp. nov. (misidentified as *S. reptans*: Kott 1985) known only from the Great Barrier Reef (see below). The group of species with lobed follicles known mainly from the Pacific and Indian Oceans contains more widely ranging species that are more difficult to distinguish from one another. In fact, in discussing *Symplegma* species from the Indian Ocean and the western Pacific, Van Name (1945: 233) was of the opinion that 'the exact status of the Old World forms does not seem to be satisfactorily settled'. This statement remains true to this day. The species in this group that are discussed below are *Symplegma bahraini* C. and F. Monniot, 1997, *S. brakenhielmi* (Michaelsen, 1904), and *S. rubra* Monniot, 1972. Of these species, the last two have a pan-tropical recorded range and *S. bahraini*, from the Arabian Gulf and the western and eastern Indian Ocean, resembles *S. alterna* Monniot, 1988, from New Caledonia, and may be a junior synonym.

Other stolidobranch ascidians are not common in these collections although massive aggregates of large, solitary *Pyura* and *Microcosmus* species with tough leathery tests were taken from harbour installations in Cullen Bay, Darwin Harbour. Light-microscopy of siphonal armature is essential for the identification of these species.

Large solitary phlebobranchs were not taken at all in these collections although the colonial phlebobranch *Perophora modificata* Kott, 1985 (previously known only from the western Pacific) was recorded twice. Its larvae with an unique adhesive array are described for the first time. They demonstrate the extent to which ascidian larvae as well as zooids and colonies respond to environmental pressures, in this case acquiring an unusually large number of adhesive organs that ensure firm attachment for the large, almost spherical larvae in shallow coralline habitats where strong tidal currents prevail.

Abbreviations. The museums holding the specimens referred to in this work are indicated by the relevant acronym preceding the reference number of the specimen, as follows: Museum and Art Gallery of the Northern Territory, Darwin (NTM); Queensland Museum, Brisbane (QM); South Australian Museum (SAM); Western Australian Museum (WAM).

The sign < or > before a taxon name indicates, respectively, a senior or a junior synonym relative to the name that precedes it.

New species (sp. nov.), although sometimes informally referred to in preceding pages, are formally described on pages marked * in the index to this paper.

Species reported in this study

PHLEBOBRANCHIA

Corellidae Lahille, 1888 (Rhodosomatinae Seeliger, 1893)

Rhodosoma turcicum (Savigny, 1816)

Perophoridae Giard, 1872

Ecteinascidia sluiteri Herdman, 1906

Perophora modificata Kott, 1985

APLOUSOBRANCHIA

Polycitoridae Michaelsen, 1904

Eudistoma carnosum Kott, 1990

Eudistoma ovatum (Herdman, 1886)

Eudistoma sluiteri Hartmeyer, 1909

Eudistoma tumidum Kott, 2001

Holozoidae Berrill, 1950

Distaplia mikropnoa (Sluiter, 1909)

Distaplia racemosa Kott, 1990

Distaplia turboensis sp. nov.

Polyclinidae Milne Edwards, 1841

Polyclinum glabrum Sluiter, 1895

Polyclinum psammiferum Hartmeyer, 1911

Polyclinum saturninum Savigny, 1816

Polyclinum tsutsuii Tokioka, 1954

Aplidium clivosum Kott, 1992

Aplidium ritteri (Sluiter, 1895)

Didemnidae Giard, 1872

Leptoclinides acicnlns Kott, 2001

Leptoclinides brandi Kott, 2001

Leptoclinides constellatus Kott, 2001

Leptoclinides echinus Kott, 2001

Polysyncraton alingnum sp. nov.

Polysyncraton arvum sp. nov.

Polysyncraton niveum sp. nov.

Didemnum albopunctatum Sluiter, 1909

Didemnum aratore sp. nov.

Didemnum clavum Kott, 2001

Didemnum domesticum sp. nov.

Didemnum jedanense Sluiter, 1909

Didemnum lillipution sp. nov.

Didemnum madeleinae F. and C. Monniot, 2001

Didemnum membranaceum Sluiter, 1909

Didemnum nekozita Tokioka, 1967

Didemnum ossium Kott, 2001

Didemnum roberti Michaelsen, 1930

Didemnum rota sp. nov.

Didemnum tunnlatum sp. nov

Didemnum usitatum sp. nov.

Didemnun vesperi sp. nov.

Tridemnum discrepans (Sluiter, 1909)

Tridemnum farrago sp. nov.

Tridemnum marmoratum (Sluiter, 1909)

Tridemnum planum Sluiter, 1909

Tridemnum pseudodiplosoma (Kott, 1962)

Lissoclinum badium F. and C. Monniot, 1996

Lissoclinum bistratum (Sluiter, 1905)

Lissoclinum multifidum (Sluiter, 1909)

Lissoclinum regium Kott, 2001

Lissoclinum taratara C. and F. Monniot, 1987

Lissoclinum timorense (Sluiter, 1909)

Diplosoma translucidum (Hartmeyer, 1909)

Diplosoma versicolor Monniot, 1994

STOLIDOBRANCHIA

Styelidae Sluiter, 1895 (Styelinae Herdman, 1881)

Symplegma bahraini C. and F. Monniot, 1997

Symplegma brakenhielmi (Michaelsen, 1904)

Symplegma rubra Monniot, 1972

Symplegma ternakii sp. nov.

Pyuridae Hartmeyer, 1908

Pyura gangelion (Savigny, 1816).

Microcosmus exasperatus Heller, 1878

Additional species recorded. In addition to the species discussed below, the following well documented and widely ranging species are reported:

Clavelinidae — *Clavelina arafurensis* Tokioka, 1952 (see Kott 1990): Ashmore Reef, NTM E276. *Clavelina meridionalis* (Herdman, 1891) (see Kott 1990): Ashmore Reef, NTM E260. *Clavelina moluccensis* (Sluiter, 1904) (see Kott 1990): Ashmore Reef, NTM E275. *Clavelina robusta* Kott, 1990 (see F. and C Monniot 2001): Lee Point, QM G308752.

Polycitoridae — *Cystodytes dellechiajei* (Della Valle, 1877) (see Kott 1990): Ashmore Reef, NTM E267. *Cystodytes philippinensis* (Herdman, 1886) (see Kott 2003): Darwin, QM G308665. *Polycitor circes* Michaelsen, 1930 (see Kott 1990, 2002): Bynoe Harbour, QM G308698-9. *Endistoma eboreum* Kott, 1990 (see Kott 2003): Ashmore Reef, NTM E291 (Fig. 22A).

Holozoidae — *Sigillina signifera* (Sluiter, 1909), (see Kott 1990): Ashmore Reef, NTM E247. *Sycozoa seiziwadai* Tokioka, 1952 (see Kott 2002): Ashmore Reef, NTM E270; Darwin, QM G308640-3; Bynoe Harbour, QM G308689. *Hypodistoma deerratum* (Sluiter, 1895) (see Kott 2002): Ashmore Reef, NTM E243; Darwin, QM G308636; Bynoe Harbour, QM G308690.

Pseudodistomidae — *Pseudodistoma gracilum* Kott, 1992 (see F. and C. Monniot 2001): Darwin, QM G308657.

Polyclinidae — *Synoicum macroglossum* (Hartmeyer,

1919) (see Kott 2003): Darwin, QM G308658). *Aplidium caelestis* Monniot, 1987 (see Kott 1992): Darwin, QM G308673. *Aplidium multiplicatum* Sluiter, 1909 (see Kott 2003): Darwin, QM G308653-4.

Didemnidae — *Leptoclinides dubius* (Sluiter, 1909) (see Kott 2004a): Bynoe Harbour, QM G308728. *Leptoclinides rigidus* Kott, 2001 (see Kott 2004): Bynoe Harbour, QM G308708 G308718. *Polysyncraton cuculliferum* Sluiter, 1909) (see Kott 2002): Bynoe Harbour, QM G308715. *Polysyncraton glaucum* Kott, 2001: Bynoe Harbour, QM G308736. *Polysyncraton puron* C. and F Monniot, 1987 (see Kott 2002): Bynoe Harbour, QM G308707, G308726. *Didemnum cygnus* Kott 2001: Bynoe Harbour, QM G308716. *Didemnum fragile* Sluiter, 1909 (see Kott 2001): Bynoe Harbour, QM G308741. *Didemnum fuscum* Sluiter, 1909 (see Kott 2001): Bynoe Harbour, QM G308730. *Didemnum molle* Herdman, 1886 (see Kott 200): Ashmore Reef, NTM E234-5; Scott Reef, WAM 111.90. *Didemnum moseleyi* (Herdman, 1886) (see Kott 2001): Bynoe Harbour, QM G308713. *Didemnum psammatode* (Sluiter, 1895) (see Kott 200): Darwin, NTM E231; Bynoe Harbour, QM G308701, G308734. *Trididemnum pigmentatum* Kott, 2001 (see Kott 2004): Bynoe Harbour, QM G308714. *Trididemnum savignii* (Herdman, 1886) (see Kott 2004): Bynoe Harbour, QM G308721, G308746. *Lissoclinum calycis* Monniot, 1992 (see Kott 2001): Bynoe Harbour, QM G308749. *Lissoclinum roseum* Kott, 2001 (see Kott 2004): Bynoe Harbour, QM G308735. *Diplosoma listerianum* (Milne Edwards, 1841) (see Kott 2001): Darwin, NTM E274. *Diplosoma virens* (Hartmeyer, 1909) (see Kott 2002): Bynoe Harbour, QM G308743.

Ascidiidae — *Phallusia julinea* Sluiter, 1919 (see Kott 1985): Darwin, QM G308675. *Phallusia millari* Kott, 1985 (see Kott 1985): Darwin, QM G308656.

Styelidae — *Polycarpa papillata* (Sluiter, 1885) (see Kott 1985): Darwin, NTM E232, QM G308652. *Polycarpa pigmentata* (Herdman 1906) (see Kott 1985): Ashmore Reef, NTM E280. *Botrylloides leachii* (Savigny, 1816) (see Kott 2001): Bynoe Harbour, QM G308722.

Pyuridae — *Microcosmus helleri* Herdman, 1882 (see Kott 1985): Darwin, QM G308647.

TAXONOMY

Family Corellidae
Subfamily Rhodosomatinae
Rhodosoma turcicum (Savigny, 1816)

Phallusia turcica Savigny, 1816: 102.

Rhodosoma turcicum – Kott 1985: 85 and synonymy; 2003: 1613.

Distribution. The species has a remarkable range encircling the tropics in a wide latitudinal band from the western Atlantic (the Caribbean) and the Mediterranean, the eastern Pacific off California and Chile, the western Pacific, around the Australian coast, Indonesia, the Philippines, southern Japan, China and the Gulf of Siam, Sri Lanka and the Red Sea (see Kott 1985). The species is recorded from shallow sub-tidal waters down to 118 m. Despite Kott's report of its rare occurrence at Heron Island, it is regularly encountered there, though only one or two specimens are recorded at a time and reports from other locations reflect a similar sparse density distribution. Neither its strategies for gene flow through such a wide geographic range, nor the mechanisms for fertilisation in its apparently sparse populations are known. It is possible that the relatively rare specimens usually encountered have their genesis in more crowded poluations in habitats not yet explored. The new record is from Ashmore Reef (NTM E271).

Family Perophoridae
Ecteinascidia sluiteri Herdman, 1906

Ecteinascidia sluiteri Herdman, 1906: 300. – Kott, 2003 and synonymy.

Distribution. *Previously recorded* (see Kott 2003): Queensland (northern Great Barrier Reef, Coral Sea Plateau), Micronesica, New Caledonia, Palau Islands, Singapore, Sri Lanka, Mozambique. *New record*: Ashmore Reef, NTM E246.

Remarks. The newly recorded specimens have the characteristic longitudinal bands of short parallel muscles.

Kott (1985) commented that she found the species, taken at low tide, to be the common perophorid on rubble at Lizard Island. The relatively sparse records of this widely ranging Indo-West Pacific species may be because it is inconspicuous in its cryptic habitats.

Perophora modificata Kott, 1985

(Fig. 2A–E)

Perophora modificata Kott, 1985: 104. – Monniot 1997: 562; F. and C. Monniot, 2001: 301.

Distribution. *Previously recorded* (see Kott 1985; F. and C. Monniot 2001): Queensland (northern Great Barrier Reef, Coral Sea Plateau), New Caledonia, Palau Islands, Philippines. *New records*: Ashmore Reef, NTM E261, E286.

Description. The species form colonies of separate zooids joined to a basal network of branching and anastomosing stolons. In both the newly recorded colonies the long axis of the zooids is dorso-ventral, the atrial aperture being terminal and the stalk is from the posterior-ventral end of the zooid near the posterior end of the endostyle. In both the newly recorded colonies the atrial aperture is on a siphon that is turned toward the anterior side of the zooid so that it faces the same way as the short branchial siphon, which is halfway down the side of the body and directed to the side. The characteristic highly vascularised extension of the body wall projects into the stalk from the postero-ventral corner of the body (at the posterior end of the endostyle). About 20 fine longitudinal muscles (on each side of the body) extend from the interspace between the apertures and the branchial siphon. On the right, these muscles terminate at the opposite

Fig. 2. *Perophora modificata*: **A**, NTM E261, colony; **B**, NTM E261, abdomen; **C**, **D**, **E**, NTM E286, larvae from the front, left side and dorsum respectively. Scale bars: **A**, 1.0 mm; **B-E**, 0.1 mm.

(posterior) margin, although the most ventral bands bend toward the endostyle. On the left, all the muscles terminate along the distal limb of the gut loop. The gut forms a simple loop along the upper two-thirds of the dorsal side of the body. Two stolonie vessels, one each side of the vascular extension are in the stalk and connect with the vessel in the basal stolon. Four rows, each of about 30 stigmata, are in the branchial sac, and about 14 entire and uninterrupted inner longitudinal branchial vessels on each side are supported on short papillae on the transverse vessels. The stomach is round and smooth-walled, and a short duodenum and small rounded posterior stomaeh arc in the proximal limb of the gut loop.

A circle of small pyriform testis follicles surrounds the proximal end of the vas deferens in the pole of the gut loop in one of the colonies (NTM E261). In the other colony (NTM E286) a single line of four or five large spherical embryos are in an incubatory pouch in the right pallial body wall around the postero-dorsal curve of the zooid (see Goodbody and Cole 1987). Both these colonies were collected in October. As well as having a large spherical balloon-like trunk with the small oozooid in the posterior end, the larvae are unusual in having sessile adhesive organs in a double row, each row of ten, around the antero-median margin, just to the right of the tail where it encireles the trunk. The larvae have an otolith and an ocellus and four long rows of small stigmata on each side of the gaping larval pharynx. A small, simple gut loop (with a clump of small, crowded testis follieles in the pole of the loop) is at the posterior end of the pharynx. The broad, flat larval tail, twisted through 90° (a eharacteristic of this family) is wound about two thirds of the way around the trunk. Dark pigment particles tend to obscure the anterior part of the larval trunk.

Remarks. Although there is some variation in the length of the zooid stalks in this species there are few other intraspecific variations. Specimens are invariably a clear yellow colour in life, although there is some variation in their colour in preservative. The two stolonic vessels, the vascularised extension of the body wall into the stalk, the orientation of the zooids, the circle of numerous testis follicles and the remarkable balloon-shaped larvae are characteristic of the species. The numerous testis follicles arranged in a eirele are reminiseent of the testis follicles in *Ecteinascidia* spp. (see *E. diaphanis* Sluiter, 1885; Kott 1985) and usually are not found in the present genus. The

testis follicles in the type specimen of this species were larger and more club-shaped than in many of the zooids in newly recorded material. The testis follicles may become longer as they mature

The species most closely related to the present one is *Perophora longicaulis* Kott, 2003, which has similar colonies, vascular stolons and a vascularised extension into the stalk. It is distinguished from the present species by its smaller zooids and interrupted internal longitudinal branchial vessels.

Family Polycitoridae

Eudistoma carnosum Kott, 1990

Eudistoma carnosum Kott, 1990: 201.

Distribution. *Previously recorded* (see Kott 1990): Western Australia (Houtman's Abrolhos to Cockburn Sound). *New record*: Northern Territory (Darwin, QM G398661).

Description. The newly recorded colony is a firm cushion encrusting an hemispherical substrate. The living colony is a bluish-black colour and in preservative it has black pigment gathered into spherical patches in the surface. Zooids open separately, about ten branchial openings in a circle, each circle surrounding a central depression or rudimentary common cloacal cavity in the surface that receives the atrial apertures. Oval clumps of white particles that appear to be intracellular, crystalline, calcareous deposits in large, spherical vesicles (similar to bladder cells) are evenly space, but become more sparse toward the base of the colony. These vesicles make the surface layer of gelatinous, translucent test look frothy. Zooids are black in the preserved colony and are very contracted. They have the usual long atrial siphon, three rows of stigmata, a very long oesophageal neck and a slightly elongate stomach and rounded posterior stomach in the gut loop.

Remarks. The present species is distinguished from others with rudimentary common cloacal cavities by the lack of sand in the test and the presence of the calcareous deposits in the large vesicles in the test. The newly recorded colony considerably extends the known geographic range of the species, formerly known only from the mid-Western Australian coast.

Eudistoma ovatum (Herdman, 1886)

(Fig. 3A–C)

Psammaplidium ovatum Herdman, 1886: 246.

Eudistoma ovatum – Kott 1972: 43.

Not *Eudistoma ovatum* – Hastings 1931: 82; Kott 1990: 222 < *Eudistoma pyriforme;* F. and C. Monniot 2001: 243 < *Eudistoma carnosum.*

Distribution. *Previously recorded*: Northern Australia (Torres Strait, Herdman 1886; Gulf of Carpentaria, Kott 1972). *New records*: Northern Territory (Bynoe Harbour, QM G308678, G308751).

Description. The newly recorded colonies are soft, sessile cones about 5 cm high, although plate-like or lobed colonies to 10 cm in maximum extent and up to 5 cm in thickness have been reported (Kott 1972). A sparse layer of sand, shell particles and faeces are in the surface test and coarser particles are on the base of the colonies, but embedded particles are not in the internal test which is transparent and especially soft. Zooids are crowded and parallel to one another, projecting obliquely into the centre of the colony. Their separate openings to the surface are obscured by the sand in the surface test, although they do not seem to form rudimentary common cloacal systems. Relaxed zooids are 8–10 mm long. Fine longitudinal muscles from the siphons join into about six bands on each side of the thorax and continue along each side of the abdomen. Beneath the longitudinal muscles are about 21 crowded parallel transverse muscles on the thorax. Although circular muscles are on each of the siphons they do not form the conspicuous bulging sphincters of many species in this genus. Sixteen long stigmata are in each of the three rows on each side of the body. The short stomach, long duodenum (slightly expanded distally) and a small onion-like expansion where the mid-intestine enters the posterior stomach are all at the posterior end to the long abdomen at the distal end of the descending limb of the gut loop. The long, posterior stomach is bent in the pole of the secondary gut loop and opens into a stiff, rigid, yellowish length of gut that has a cuticle-like appearance and makes a complete clockwise (when viewed from the left side) coil or double loop in the posterior end of the abdomen before opening into the soft flexible intestine containing the line of faeces pellets that occupy the whole of the ascending limb of the gut loop and dominate the internal appearance of this species.

The newly recorded colonies (collected in July) contain up to two embryos, one a tailed larva which sometimes is oriented across the atrial cavity with its anterior end in the base of the atrial siphon. The larvae are identical with those found in the material from the Gulf of Carpentaria (Kott 1972). The small trunk is 0.6 mm long with two pairs of lateral ampullae along each side of the three antero-median adhesive organs and a median dorsal and median ventral ampulla each with a long posterior extension.

Remarks. Despite some variation in the appearance of the colonies, the newly recorded colony and specimens from the Gulf of Carpentaria (Kott 1972) have the same distribution of sand in the colony and the same large zooids, muscles, branchial sac and the double loop of the gut at the posterior end of the body as described for the type species by Herdman (1886) and Hastings (1931).

Although Hastings (1931) thought that the presence of either a kink or a coil in the proximal part of the ascending limb of the gut loop was not significant as a specific character, it is clear from examination of the newly recorded specimen that it is not only the course of the gut but also the consistency of its coiled part that is affected and that coil in the pole of the gut loop together with its

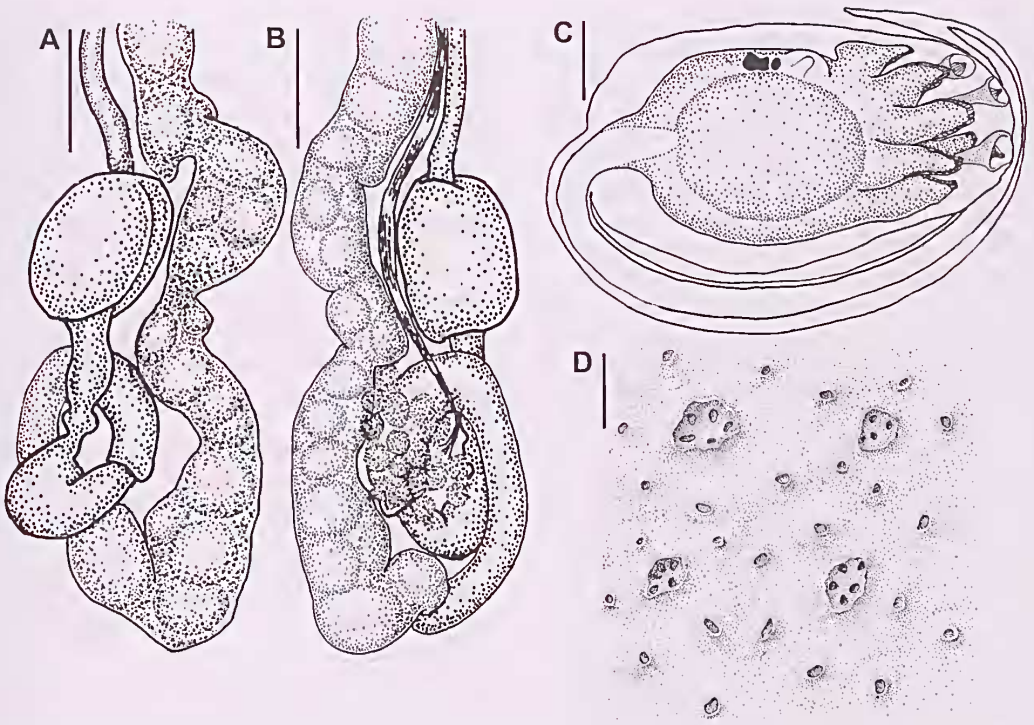

Fig. 3. *Eudistoma ovatum*: **A**, **B**, QM G308678, views of the abdomen showing the coiled gut loop and gonads; **C**, QM G308751, larva. *Eudistoma sluiteri* (QM G308753): **D**, surface view of colony showing rudimentary common cloacal cavity. Scale bars: **A**, **B**, 0.5 mm; **C**, 0.1 mm; **D**, 1.0 mm.

rigid cuticle-like gut wall is a significant character distinguishing the present species from others in the genus. The specimens found to have been erroneously assigned to this species have the proximal part of the ascending limb of the gut loop kinked rather than characteristically coiled. *Eudistoma ovatum* F. and C. Monniot has circular systems, crystals in the test and a large larval trunk with two rows of numerous lateral ampullae on each side of the antero-median adhesive organs, all suggesting that it may be a specimen of *Eudistoma carnosum*. The sandy specimens described by Hasting (1931) and Kott (1990) from the Great Barrier Reef and Hasting's specimen from Cape Boileau appear to be another sandy Australian *Eudistoma* sp., *E. pyriforme* (Herdman, 1886), which has the gut kinked rather than looped, and has sand crowded throughout the test rather than mainly being in a layer on the surface. *Eudistoma vulgare* Monniot, 1988, with a similar larva as that described for *E. ovatum*: Kott, 1990 and *E. arenaceum* Sluiter, 1909, appear also to be synonyms of *E. pyriforme*.

Other species reported to have two spirals in the pole of the gut loop are *Polycitor scaber* Sluiter, 1909 and *P. spirifer* Sluiter, 1909. However, the former (although it has three rows of stigmata and probably is an *Eudistoma* sp.) is reported to have only six stigmata per row and the latter to have four rows of stigmata.

Eudistoma sluiteri Hartmeyer, 1909

(Figs 3D; 22B)

Eudistoma sluiteri Hartmeyer, 1909: 1488 (*nom. nov.* for *Polycitor mollis* Sluiter, 1909). – Kott, 1998: 111.

Distribution. *Previously recorded* (see Kott 1990): Queensland (Great Barrier Reef); Indonesia. *New records*: Northern Territory (Darwin, QM G308638, G308662, G308668-9, G308672, G308753).

Description. The colonies are robust, often extensive slabs sometimes with some rounded elevations on the surface. The test is firm, gelatinous without sand or other inclusions. The upper surface is even and the zooids are arranged in wide circles of about ten, each circle surrounding a small central saucer-shaped rudimentary common cloaca which is depressed into the surface of the colony with its margin projecting from the surface. Living colonies are a beige, grey or brown externally, but collectors report the internal colour always to be brown. The test of the preserved colony is reddish-brown to black, the pigments concentrated in a layer at the surface and a wide band at the level of the upper half to two-thirds of the basal half of the colony. Between these bands of pigment, the test is translucent. Zooids are black in preservative and have the usual longitudinal and transverse muscles, long six-lobed atrial siphon and the very long oesophageal neck with the stomach and gonads in the gut loop at the posterior end of the long abdomen.

Remarks. Although Kott (1990) did not observe the rudimentary common cloacal cavities of this species they are present in all the newly recorded specimens, the elevated margins of the depressions supporting their status as cloacal cavities rather that merely surface depressions. Also, the zooids figured by Kott (1990: fig. 84a-c) were contracted and presumably this obscured the very long oesophageal neck of species of this genus. However, the stomach and gonads are in the gut loop at the posterior end of the abdomen. Like *E. carnosum* the lack of contained sand distinguishes the species from others with rudimentary common cloacal cavities, and the lack of the large crystalline-filled vesicles distinguishes the species from *E. carnosum*. The external colour of colonies of this species is very variable.

Eudistoma tumidum Kott, 1990

Eudistoma tumidum Kott, 1990: 232. – F. and C. Monniot: 2001: 245.

Distribution. *Previously recorded* (see F. and C. Monniot 2001): Gulf of Carpentaria; Philippines. *New record*: Northern Territory (Darwin, QM G308639).

Description. The newly recorded colony (collected in September) consists of irregular rounded elevations from a basement membrane. Zooids are arranged in circular (but not cloacal) systems. Some sparsely distributed sand is in the test. Larvae are present and resemble those described for the type material and those from the Philippines (collected in March: F. and C. Monniot 2001). The larval trunk is small (0.5 mm long) and long, pointed lateral ampullae, each with a parietal accessory lobe at the base, are along each side of the three antero-median adhesive organs. Both the dorsal and ventral median ampulla has a posteriorly projecting extension from its base.

The shape of the colony appears to be consistent. Kott's (1990) prediction that in living specimens the surface lobes would be crowded together to form an hemispherical mass is incorrect. As well as the colony shape, the small larvae contribute to the definition of the species. Despite F. and C. Monniot's (2001) suggestion, and the fact that both species have similar small larvae, this species does not resemble *Eudistoma ovatum* in any way.

Family Holozoidae

Distaplia uikropnoa (Sluiter, 1909)

Polyclinum mikropnous Sluiter, 1909: 94.

Distaplia mikropnoa – Kott 2002: 24 (part, not specimen NTM E200 < *D. racemosa*) and synonymy.

Distribution. *Previously recorded* (see Kott 2002): Northern Territory (Darwin); Palau Islands, Indonesia. *New records*: Ashmore Reef, NTM E252; Northern Territory (Darwin, QM G308702).

Description. The newly recorded colonies are soft cushions and lack the stalk reported previously for the species. In all other characters, the colonies and zooids resemble those previously described, with double rows of zooids converging to two or three common cloacal apertures on the top of the colony. Gonads are in a sac behind the abdomen, fine parallel folds are in the stomach wall and, as previously described for this species, a flag of tissue is attached to the rectum.

Remarks. Despite the few previous records of this species, it is readily identified and appears to be a reasonably common component of the Indo-west Pacific fauna.

Distaplia racemosa Kott, 1990

(Figs 4A, 22C)

Distaplia racemosa Kott, 1990: 124.

Distaplia cuspidis Kott, 2002: 23 and synonymy (new synonym).

Distribution. *Previously recorded* (see Kott 1990, 2002): Northern Territory (Arafura Sea), Palau Islands. *New records*: Northern Territory (Darwin, NTM E297; Bynoe Harbour, QM G308686, G308691-4, G308745, G308747).

Description. The newly recorded colonies, as described previously for this species, are pink/white slabs with clouds of a white deposit that surrounds the pink zooids in the surface of the colony and becomes more diffuse internally. In preservative, one of the colonies (QM G308693) is a bright raspberry-colour externally and paler internally but the others are beige or cream-coloured. Similar variations in colour can be seen in the photographs of living colonies. The test is soft and translucent, but tough and fibrous and the posterior abdominal stolons cross one another in the basal or central test. Sand and other debris often are embedded in the base of the colony. Longitudinal thoracic muscles are strong, extending from the branchial siphon and from the vicinity of the endostyle to the posterior end of the thorax. When contracted, the dorsal muscles draw up the dorsal margin of the body and change the orientation of the thorax so that the conspicuous muscles from the endostyle to the posterior end of the thorax appear to be transverse. Thoraces are large and, although both the musculature and the branchial sac are obscured by contraction, about 20 or more stigmata can be detected in each of the four rows. The gut loop is long and narrow, the stomach smooth-walled and shield shaped, and a small ovary is in the centre of a tight mass of 20 or more testis follicles in the posterior end of the gut loop. Newly recorded colonies from Ashmore Reef and Bynoe Harbour (collected in October and June, respectively) have a single large larva developing in each brood pouch. The tail extends to the anterior end of the larval trunk (1.6 mm long) where three sessile cup-shaped adhesive organs are radially arranged. The oozooid is in the postero-dorsal corner of the long trunk. Four rows of small circular stigmata puncture the larval pharynx and a short oesophagus, pear-shaped stomach and long straight rectum are in the oozooid. Fine transverse muscles can be detected in the thoracic wall of the oozooid but longitudinal muscles were not observed. An irregular mass

of yolk is in the anterior half of the trunk behind the three triradially arranged adhesive organs consisting of short adhesive cones in epidermal cups on long, cylindrical almost parallel stalks. Although only 12 perforations are in each half-row in the oozooid, at least twice that number are in the adult thorax.

Remarks. Kott (2002) misinterpreted the muscles in this species, and, believing they were transversely orientated, used that character to distinguish a new species, *Distaplia cuspidis*. However, as in other species of this genus, the muscles of the thoracic wall are, in fact, longitudinal and oblique, albeit they may be more numerous than in other species. The species is distinguished by its soft fibrous test, irregular surface, long double row systems that look circular when the zooids are drawn in around the large common cloacal apertures, posterior abdominal stolons crossing one another in the basal test smooth stomachs, and gonads in the gut loop. *Distaplia prolifera* Kott, 1990, from north-western Australia, has a larger larva than the present species, but the anterior end of its trunk divides into three thick bulbous stalks, each with an adhesive organ on the tip and its gonads are in a sac posterior to the abdomen.

Distaplia turboeusis sp. nov.

(Fig. 4B–D)

Distaplia australiensis – Kott 1990: 113 (part, QM GH2158 only); Kott 2003: 1619.

Distribution. *Type locality*: Northern Territory (Bynoe Harbour, Dawson Rock mud, 5–8 m, coll. H. Nguyen, 23 May 2003, holotype NTM E321, paratype QM G308748). *Previously recorded* (see Kott 2003): Queensland (Calliope River, Gladstone; Moreton Bay).

Description. Colonies are small (up to 1 cm diameter) sessile cone or turban-shaped heads attached to irregular branching basal stalks that are sometimes expanded into a membrane. Vertical double rows of zooids along the sides of the colony converge to one or two large, sessile terminal common cloacal apertures. Characteristic disapliid zooids have short six-lobed atrial openings and large assymetrical atrial apertures, each with an anterior lip opening into the long common cloacal canals. Fine longitudinal muscles are in the thoracic body wall and curve out into the atrial lip. Four rows of 14 stigmata per side, each row crossed by a fine parastigmatic vessel are in the branchial sac. A short stomach, about halfway down the abdomen, has about 24 fine parallel longitudinal ridges in its wall that end abruptly in a transverse line across the gut where it changes to a short thin-walled duodenal area, followed by a long, cylindrical intestine and rectum. A fine gastro-intestinal duct, from a point near the cardiac end of the stomach, extends posteriorly to a delicate rounded reservoir in the centre of the gut loop. The afferent duct from the posterior wall of the gastric reservoir breaks into terminal branches about two-thirds of the way down its length and these enter the intestine in the pole of the gut loop. The rectum occcupies the ascending limb of the gut loop and the bilabiate anal opening is next to the opening of the vas deferens just inside the posterior rim of the atrial opening. A long narrow brood pouch containing, end to end, two cigar-shaped embryos (the most advanced at the top of the pouch) is attached, by a long, straight duct, to the body wall just behind the atrial aperture. The compact posterior abdomen, containing a barrel-like cluster of five or six short, parallel testis follicles and a small five-egg ovary at its posterior end is constricted from the abdomen by a short neck. A fine vascular stolon from the side of the abdomen extends down into the centre of the colony. Larvae, in the newly recorded specimen collected in May, have three triradially arranged adhesive organs on thick balloon-like stalks, a relatively short tail reaching only about half the way along the ventral surface of the long, narrow 1.5 mm trunk, well formed adult organs, a mass of yolk and spherical vesicles in the larval test.

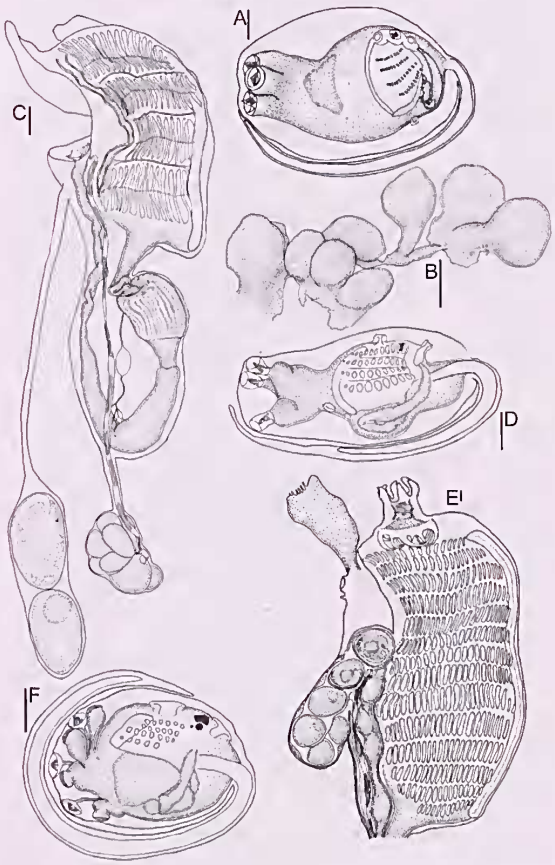

Fig. 4. *Distaplia racemosa* (QMG308686): **A**, larva. *Distaplia turboensis* sp. nov. (QM G308748 paratype): **B**, colony; **C**, zooid; **D**, larva. *Polyclinum tsutsuii* (NTM E273): **E**, thorax; **F**, larva. Scale bars: **A**, **E**, **F**, 0.1 mm; **B**, 1.0 cm; **C**, **D**, 0.2 mm.

Remarks. *Distaplia australiensis* is known principally from southern Australia, although Kott (1990, 2003) had assigned specimens from central and southern Queensland respectively, to it. Like the newly recorded Northern Territory material, these specimens differ from the temperate species in having about twice the number of stomach folds, 14 stigmata per half row (rather than about 20) and smaller less regular colonies with sessile heads attached to irregular branching stalks or flattened basal membranes (rather than the long, narrow cylindrical stalks and rounded heads of *D. australiensis*).

The species name relates to the top-shaped colony (turbo, n.= a top).

Family Polyclinidae

Polyclinum glabrum Sluiter 1895

Polyclinum glabrum Sluiter, 1895: 168. – Kott 2001: 448 and synonymy.

Distribution: *Previously recorded* (see Kott 2001):NW Australia (Montebello Islands), NE Australia (Capricorn Group), Indonesia. *New record*: Northern Territory (Darwin, QM G308664).

Description. The newly recorded colony is soft and irregular in preservative, but the *in situ* photograph shows it to have been translucent, pale blue grey with the upper surface raised into sessile, rounded or conical prominences with zooids along each side of canals converging to the terminal common cloacal apertures. Zooids have a long forked atrial tongue from the body wall just anterior to the opening and a small papillum behind the opening. Fourteen rows of stigmata are separated from one another by transverse bars with conspicuous branchial papillae. Gonads are in an almost spherical posterior abdomen constricted off from the abdomen by a short neck.

Remarks. The rather regular systems, with longitudinal common cloacal canals converging to the terminal common cloacal apertures, are obscure when the soft colonies are fixed and collapsed and are seen only in the photograph of the living specimen.

Polyclinum psammiferum Hartmeyer, 1911

Polyclinum psammiferum Hartmeyer, 1911: 1461 (*nom. nov.* for *P. sabulosum* Sluiter, 1900: 96). – Kott 1998: 124 and synonymy; F. and C. Monniot 2001: 223.

Distribution. *Previously recorded* (see Kott 1990; F. and C. Monniot 2001): Queensland (Moreton Bay, Hervey Bay, Capricorn Group), Palau Islands, Indonesia. *New record*: Northern Territory (Bynoe Harbour, QM G308688).

Description. In preservative, the colony is a soft, shapeless cushion with a single layer of sand adhering to parts of the creased and folded upper surface and to the under surface. The living specimen appears to be hemispherical with the upper surface raised into low rounded swellings. The internal test is soft and translucent without any included sand and the zooids are crowded together vertical to the surface. At the anterior end of the long thorax the branchial aperture, surrounded by six pointed lobes, is on a short siphon. A long, narrow atrial tongue projects from the antero-dorsal aspect of the thorax, distant from the anteriorly directed excurrent opening on a short, narrow atrial siphon. A small atrial papilla is posterior to the atrial siphon in the mid-dorsal line. Branchial tentacles are crowded and especially long. Stigmata are in 12–14 rows, about 12 per row. Only five narrow bands of muscle extend down each side of the thorax. Fine transverse muscles are in the transverse interstigmatal vessels, but branchial papillae are not present on these vessels. The abdomen and the gut loop are relatively short and the distal part of the gut loop is twisted as is usual in this genus. The stomach is spherical and smooth-walled. The gonads are in a relatively long, spindle-shaped posterior abdomen connected to the abdomen by a short, narrow constriction. A number of eggs in a small ovary are embedded about two-thirds of the distance down the long cluster of about 24 male follicles. Fertilisation appears to take place in the thoracic part of the oviduct and a brood pouch is not present. In the newly recorded specimen, collected in March, about four embryos and larvae (the larval trunk 0.42 mm long) are in a developmental sequence in the oviduct as it moves up the posterior half of the thorax. Five long median ampullae each with a shorter lateral ampulla on each side of its base alternate with the three antero-median adhesive organs. A clump of epidermal vesicles separates from a postero-ventral stalk and a clump of antero-dorsal vesicles branches from a similar stalk that projects back from the branchial aperture of the zooids. Three calcium oxalate crystals are on the side of the thorax of the oozooid.

Remarks. Most characters of the newly recorded specimen have been described previously for this species. Exceptions are the number of stigmata, which F. and C. Monniot (2001) found to be 22 per row, although Kott (1992) found about 12 per half row. Also, Kott (1992) found the ovary anterior to the testis follicle while F. and C. Monniot (2001) found the eggs dispersed along the whole length of the testis. Larvae are like those of the temperate Australian *P. marsupiale* Kott, 1963 (although the latter species does have a brood pouch) and *P. saturnium* Savigny, 1816. Both these latter species have conspicuous branchial papillae that distinguish them from the present one. Characteristics of the present species are the soft colonies lacking internal sand, fine muscle bands, absence of a brood pouch and lack of branchial papillae, a spindle-shaped posterior abdominal sac and small larvae with lateral and median larval ampullae.

F. and C. Monnniot (2001) refer to the calcium oxalate crystal as always present in this genus. One to three of these crystals have been observed in many of the known species. They appear to be in the larval test, often (though not always) on each side of the thorax. There is no known explanation for their presence.

Polyclinum saturnium Savigny, 1816

Polyclinum saturnium Savigny, 1816: 190. – Kott 1992: 455 and synonymy.

Distribution. *Previously recorded* (see Kott 1992): Western Australia (Dongara), Queensland (Heron Island), Suez, Red Sea, Philippines. *New record*: Northern Territory (Darwin) NTM E230.

Description. The newly recorded colony is a soft, flat-topped cushion with patches of sand adhering to the surface test but no sand in the soft internal test and with the under surface on barnacles and pebbles. Zooids, arranged in circular systems, are large, with a broad atrial lip from the body wall anterior to, and well separated from, the circular atrial opening. Fine longitudinal muscles are in the atrial lip and in the body wall. The atrial lip extends through the thin layer of test forming the roof of the common cloacal cavity and its tip is associated with the rim of the common cloacal opening in the centre of the common cloacal cavity. Zooids adhere to the test and are almost impossible to separate from it. Stigmata are in 10 rows of about 14 per half row and the same number of flat, rounded papillae are on the transverse interstigmatal vessels between the rows of stigmata.

Remarks. The species is distinguished by its soft, cushion-like colonies without sand in the internal test, circular systems, a broad atrial lip well separated from the excurrent aperture, the presence of branchial papillae on the transverse vessels and the absence of a brood pouch.

Polyclinum tsutsuii Tokioka, 1954

(Fig. 4E, F)

Polyclinum tsutsuii Tokioka, 1954: 240. – Kott 1967: 47; Kott 1992: 463.

Polyclinum vasculosum – Tokioka 1967: 51 (part, specimens from Marianas Islands).

Polyclinum pute C. and F. Monniot, 1987: 84. – F. and C. Monniot 1996: 144; Monniot 1987: 514.

Polyclinum corbis Kott, 2003: 1626.

Distribution. *Previously recorded* (see Kott 1992, 2003): Western Australia (Cervantes); Queensland (Heron Island), French Polynesia, New Caledonia, Marianas Islands, Kiribati, Palau Islands, Philippines, Tokhara Islands. *New record*: Ashmore Reef, NTM E273.

Description. The newly recorded colony is a fleshy slab about 5 cm in maximum dimension, with rounded margins. Preserved, it is a greenish-black colour with black zooids arranged in circular systems. Black particles in the test obscure the zooids and larvae and zooids have black particles in the body wall, especially in a velum at the base of the branchial siphon. Sometimes the branchial velum is raised in an outward projecting cone with a small terminal aperture that appears to occlude the incurrent opening. The branchial lobes are long and pointed. The atrial aperture is a small opening. A large anterior atrial lip sometimes appears to arise from the anterior rim of the opening but this is only apparent as its origin is from the body wall just anterior to the opening. Its distal tip is a straight transverse edge with a fringe of thin, parallel finger-like papillae. The thorax has fine longitudinal muscles. In the branchial sac 14 rows of stigmata have 22 stigmata per row in the centre of the sac. Flat rounded papillae, about two to each three stigmata are on the transverse membranes between the rows of stigmata. Fine transverse muscles are also in the transverse membranes. The gut loop is as previously described and the small bilabiate anal opening and the vas deferens open together at the level of the sixth row of stigmata. Gonads are in a sac posterior to the abdomen. The eggs appear to be fertilised in a U-shaped loop of the oviduct which projects out from the body about halfway up the dorsal margin of the thorax opposite the sixth or seventh row of stigmata. The distal end of the oviduct, beyond this U-shaped loop, contains the most advanced embryos in the developmental sequence of about 10 and continues anteriorly in the body wall, projecting anteriorly into the atrial cavity. A small aperture on the side of the distal part of the oviduct opens into the atrial cavity adjacent to the anal and vas deferens openings. The least developed embryos are in the descending limb of the oviducal loop in the projecting part of the brood pouch. The larvae have four lateral ectodermal ampullae along each side of the three antero-median adhesive organs. Antero-dorsal and postero ventral clumps of vesicles are present as usual in this genus.

Remarks. The brood pouch in this species is the projecting U-shaped bend in a relatively small part of the thoracic part of the oviduct and it contains only relatively immature embryos, which continue their development distal to the brood pouch before release into the atrial cavity. The brood pouch is neither pedunculate nor constricted off from the thorax as C. and F. Monniot (1987), F. and C. Monniot (1996) and Monniot (1987) imply in their descriptions of *Polyclinum pute* C. and F. Monniot, 1987.

Kott (1992, 2003) accepted the interpretation (F. and C. Monniot 1996) that embryos were present in the atrial cavity (rather than in a brood pouch) of zooids of *P. tsutsui* Tokioka, 1954 (and 1967) (from the Tokhara and Palau Islands respectively). *Polyclinum corbis* Kott, 2003 was erected to accommodate those specimens (from Heron Island and Cervantes) that did have a brood pouch. However, this synthesis cannot be reconciled with Tokioka's statement that he found an 'incubatory pouch at the level of the seventh stigmatal row' (Tokioka 1967: 49) in specimens he had assigned to *P. tsutsui* from Kiribati and the Palau Islands. This statement may have been overlooked by F. and C. Monniot (1996: 145) when they declared that they could find no 'protruding or pedunculate incubatory pouch' in Tokioka's (1967) specimens; nor did they find any larvae, although Tokioka (1967) had described one from the Palau Islands (Tokioka, 1967: 49 and fig.14g). In fact, specimens from the Palau Islands assigned to *P. tsutsuii* by Tokioka (1967) and to *P. pute* by F. and C. Monniot (1996) appear to be conspecific,

both having the characters found in other specimens assigned to this species in the synonymy above, *viz* four pairs of larval lateral ampullae as well as median ampullae, a fringed tip on the atrial lip which projects from the body wall just anterior to the atrial aperture, few and fine longitudinal thoracic muscles, about 14 rows of stigmata and 22 stigmata per row and a brood pouch consisting of a loop of the thoracic part of the oviduct projecting from the thorax at the level of the seventh row of stigmata.

Specimens from Cervantes (Western Australia) assigned to this species (Kott 1992) have median larval ampullae alternating with the adhesive organs as well as four pairs of lateral ampullae and appear to be conspecific with the present species.

The structure of the projecting brood pouch in other species in this genus has not yet been determined.

***Aplidium clivosum* Kott, 1992**

Aplidium clivosum Kott, 1992: 530 and synonymy.

Distribution. *Previously recorded* (see Kott 1992): Western Australia (Port Hedland, Montebello Islands, Cockburn Sound, Geographe Bay, Hamelin Bay), South Australia (Great Australian Bight, Spencer Gulf, Gulf St. Vincent, Kangaroo Island, Flinders Island), New South Wales (Jervis Bay), Queensland (Heron Island). *New record*: Ashmore Reef, NTM E269.

Description. The newly recorded colony is a regular inverted cone, flat on the upper surface and reducing in diameter toward the base. The upper margin of the upper surface is a rounded ridge raised above the central area where double rows of zooids converge to the central sessile common cloacal opening. Sand is thick in the outer layer of test around the outside of the colony but less sand is present internally and on the upper surface where the zooids open. Zooids are long and muscular. A narrow atrial lip extends from the body wall anterior to a short atrial siphon. Five folds are on the wall of the small stomach halfway down the abdomen and the gonads are in the long, threadlike posterior abdomen.

Remarks. The species occurs commonly around the Australian coast, and the present record is the most northerly location known. The large, robust colony is distinctive and zooids are uniform and display very little intraspecific variation.

***Aplidium ritteri* (Sluiter, 1895)**

Amaroucium ritteri Sluiter, 1895: 10.

Aplidium ritteri – Kott 1992: 580 and synonymy.

Distribution. *Previously recorded* (see Kott 1992): Queensland (Capricorn Group); Torres Strait, Palau Islands, New Caledonia, Truk, Ponape, Indonesia. *New record*: Northern Territory (Lee Point, QM G308731).

Description. The colony forms what apears to be an upright lamella. Zooids are arranged in long double row with randomly placed large common cloacal apertures amongst them and sand embedded in the test between the rows of zooids. Large variably-sized spherical vesicles that may be chlorophytes are in the test around the zooids. Zooids are narrow, with a short atrial lip from the upper rim of the aperture, 10–12 rows of about six stigmata in a half row and five stomach folds. A small ovary is at the anterior end of the short posterior abdomen of which the tip is stretched across between the tips of the two bands of longitudinal muscle. Three embryos, one a tailed larva, are in the posterior end of the atrial cavity. Larvae are small, the trunk 0.6 mm long, with three antero-median adhesive organs alternating with small conical median ampullae and obscured by epidermal vesicle from a pair of ridges, one along each side of the median line.

Remarks. The newly recorded specimen resembles those previously described (see Kott 1992). *Aplidium caelestis* is superficially similar to the present species, but its atrial tongue arises from the body wall well anterior to the opening.

Family Didemnidae

***Leptoclinides aciculus* Kott, 2001**

(Fig. 20A)

Leptoclinides aciculus Kott, 2001: 37.

Not *Leptoclinides aciculus* – Kott 2002: 29 < *Leptoclinides cuspidatus* (Sluiter, 1909). *Leptoclinides aciculus* – Kott 2004b: 2467 < *L. constellatus* Kott, 2001.

Not *Leptoclinides madara* – F. and C Monniot 2001: 288 < *Leptoclinides cuspidatus* (Sluiter, 1909).

Distribution. *Previously recorded* (see Kott 2001): NW Australia (Port Hedland); Queensland (Whitsunday Islands). *New record*: Ashmore Reef, WAM 129.90.

Description. The newly recorded specimen is a robust encrusting colony with dark pigment in finely branched pigment cells throughout, but especially crowded in streaks giving a black-grey marbled appearance to the surface of the preserved colony. Large, stellate spicules are in a crowded layer at the surface, making it raspy to the touch. A thinner, less crowded layer of spicules is on the base of the colony, but spicules are sparse elsewhere. Zooids are along each side of deep primary common cloacal canals, their position indicated on the surface by the small patch of spicules in the siphon lining. Sometimes pigment cells appear to be especially crowded in the test over the common cloacal canals. Conspicuous common cloacal apertures, at the junction of some of the primary canals, are elevated and have black rims owing to the absence of spicules. Spicules, up to 0.108 mm diameter, are stellate with nine to 11 well-spaced, conical rays in optical transverse section, and they have pointed or chisel shaped tips. Zooids are relatively small, with the abdomen folded up against the postero-ventral part of the thorax. About five male follicles are surrounded by seven coils of the vas deferens.

Remarks. The raspy colony surface with large stellate spicules in a superficial layer and a thinner, sparser layer on the base of the colony, together with the strong, well-spaced spicule rays with pointed or chisel-shaped tips and

the circular common cloacal canals, help to distinguish this species. However, not one of these characters is unique, and the species is difficult to identify. Although the size, form and distribution of spicules and the form of the colonies of *L. aciculus* Kott, 2002, from Darwin Harbour, resemble the present species, they have more spicule rays and appear to be specimens of *L. cuspidatus* (Sluiter, 1909). The latter species has a similar raspy surface, similar distribution of spicules and pigment cells, the larval trunk is 0.7–0.75 mm long and has the same lateral ampullae (see *L. cuspidatus*: Kott 2001 and its proposed synonym *L. madara*: F. and C. Monniot 2001). The spicules of *L. cuspidatus* are larger (to 0.125 mm diameter) and have more spicule rays than the present species, the zooids are larger and the gut loop is vertical rather than bent up against the postero-ventral part of the thorax. The specimen from Darwin assigned to *L. aciculus* by Kott (2004b) does not appear to be conspecific with either the present species or *L. cuspidatus*. It appears to be a specimen of *L. constellatus* having smaller spicules than either *L. aciculus* or *L. cuspidatus* and having a thin superficial aspiculate layer of test.

Leptoclinides tuberculatus Kott, 2004 has a similar raspy surface and spicule distribution to the present species, but the spicules are smaller (maximum size 0.08 mm diameter) and they have more numerous rays.

Leptoclinides brandi Kott, 2001

(Fig. 5A)

Leptoclinides brandi Kott, 2001: 40 and synonymy. – Kott 2004b: 2468.

Distribution. *Previously recorded* (see Kott 2002): Great Barrier Reef (Capricorn Group); Northern Territory (Darwin). *New records*: Northern Territory (Darwin, QM G308685; Bynoe Harbour, QM G308705, G398740, G308750).

Description. The newly recorded colonies, white in preservative, consist of one or more rounded lobes, each with a large terminal common cloacal aperture. The spicules are crowded in a single layer at the surface but are sparse internally. The branchial siphon is relatively short and but conspicuous and tulip-shaped. The atrial siphon, from the posterior part of the dorsal mid-line, is moderately long and cylindrical and is laterally directed. The branchial tentacles are numerous and especially long, projecting about halfway down the pharynx. The stigmata are characteristically spindle-shaped, pointed at each end. A small circular lateral organ is on each side of the posterior end of the thorax near the base of the atrial siphon. Five coils of the vas deferens surround five to seven testis follicles.

Remarks. Previously overlooked in this species are the exceptionally long branchial tentacles, the small thoracic lateral organs and the laterally oriented tubular atrial siphon which, with the long pointed rays of the spicules, spicule distribution, the spindle-shaped stigmata and the thoracic brood pouch (not present in newly recorded specimens) are all characteristic. The distribution of the spicules in this species resembles that in *L. dubius* (Sluiter, 1909). These species are distinguished from one another by the shape of the spicules and the stigmata, the presence of five coils of the vas deferens (rather than the one and a half coils in *L. dubius*) and tubular atrial siphon in the present species and the double gut loop and false siphon in *L. dubius*. Similar colonies (rounded swellings with terminal common cloacal openings) occur also in *L. sulawesi* F. and C. Monniot, 1996, *L. cuspidatus* (Sluiter, 1909), *L. imperfectus* (Kott, 1962) and *L. compactus* Kott, 2001. All these species have more vas deferens coils than the present one and have differences in their spicules and their distribution (see Kott 2001).

Leptoclinides constellatus Kott, 2001

(Fig. 5B)

Leptoclinides constellatus Kott, 2001: 51.

Not *Leptoclinides constellatus* – Kott 2004b: 2469.

Leptoclinides aciculus – Kott 2004b: 2467.

Distribution. *Previously recorded* (see Kott 2004b): Queensland (Whitsunday Islands); Northern Territory (Darwin). *New records*: Northern Territory (Darwin, QM G308684; Bynoe Harbour, G308594).

Description. In life the newly recorded specimens are brown over the common cloacal canals that surround lighter beige-coloured zooid-free areas. In preservative, streaks of spherical to irregular pigment cell are mixed with spicules and bladder cells in the thin surface layer of test. The spicules sometimes are patchy in the surface or they are evenly spaced or crowded into an opaque layer. They are in a thin layer on the base of the colony and line the common cloacal cavity, including its posterior abdominal component. They become sparse around the zooids and usually are sparse or absent from the basal part of the colony. The spicules have nine to 11 conical or sharply chisel-shaped rays in optical transverse section and are up to 0.0625 mm in diameter. The common cloacal cavity is posterior abdominal. Branchial siphons project through the bladder cell layer and the openings often are stellate, their margins lined with spicules. Zooids are relatively small with narrow, cylindrical branchial siphons and seven coils of the vas deferens around about five testis follicles. Larvae are present in the basal test of specimens (QM G308594) collected in June. The larval trunk is 0.6 mm long and has two pairs of lateral ectodermal ampullae and a dorsal and a ventral ampulla. The tail is wound two-thirds of the way around the trunk.

Remarks. The species is identified principally by its relatively small spicules and their distribution, the form of the cloacal systems and the presence of a surface spicule-free layer of test. It differs from other species with similar cloacal systems by its beige-brown colour,

Leptoclinides aciculus Kott, 2001 also has zooids along each side of circular canals, but it has some larger spicules. Although the spicules reported for *L. constellatus* Kott, 2004b are the same size as the present species, the shape of the spicules is the same as those of *L. rigidus*, as is the grey-blue colour of the living colonies.

***Leptoclinides echinus* Kott, 2001**

Leptoclinides echinus Kott, 2001: 59.

Leptoclinides levitatus – Kott 2004b: 2471.

Distribution. *Previously recorded* (see Kott 2001: 2004b): Western Australia (Dampier Archipelago, Port Hedland); Northern Territory (Darwin). *New record*: Northern Territory (Bynoe Harbour, QM G308724).

Remarks. The newly recorded specimen is similar to those previously described. The species was misidentified as *L. levitatus* (see Kott 2004b) but the present species lacks the smaller almost globular spicules characteristic of *L. levitatus*. The attenuated tips on the conical rays of the stellate spicules are similar in both species.

***Polysyncraton alinguum* sp. nov.**

(Figs 5C–E; 20B)

Distribution. *Type locality*: Northern Territory, Darwin Harbour, Mandorah jetty pylons, 5–8 m, coll. B. Glasby and party, 5 September 2003, holotype NTM E311, paratypes NTM E310.

Description. Colonies are soft, with the upper surface elevated into rounded swellings or lobes with terminal common cloacal apertures. The surface test contains a single thin layer of evenly distributed spicules forming a sort of veil over the surface that is interrupted by evenly distributed stellate branchial apertures. The lobes of the branchial openings are filled with, rather than outlined in, spicules. Spicules are only sparse in the remainder of the colony. The common cloacal cavity is a vast horizontal space crossed by clumps of zooids, their abdomina embedded but the thoraces separate from one another, attached to the basal layer of test or to another basal connective by a thin test ligament. These clumps of zooids are effectively suspended in the common cloacal cavity in their sling of test between surface and basal test. The thin, narrow ventral thoracic strips of test are attached to the surface beside each branchial aperture. In each colony lobe, the upper part of the common cloacal cavity is a vast uninterrupted space, the clumps of zooids anchored either directly to the basal test or to intermediate connecting strands of test. Spicules are stellate with nine to 11 conical pointed rays to 0.04 mm diameter. Rare but sparse giant spicules with a similar structure to the smaller ones, but up to 0.05 mm diameter, are evenly distributed.

Zooids are relatively small, with a short branchial aperture, although the thorax is large, rectangular and not very muscular. The atrial aperture is large, exposing most of the branchial sac directly to the common cloacal canal. Only few of the zooids have a short bifid atrial lip from the upper border of the opening. Most of the zooids have a plain curved anterior atrial rim, without a projecting lip. Ten rectangular stigmata are in the anterior row and eight are in the last row. The oesophageal neck is relatively short. A retractor muscle was not detected. Four coils of the vas deferens surround a circle of four or five testis follicles.

Remarks. Colonies of this species resemble some of those of the temperate species *Polysyncraton rica* Kott, 2001 (see Kott 2001; QM GH2387, pl. 6d, erroneously assigned to *P. pedunculatum* Kott, 2001). The superficial aspiculate layer so conspicuous in the deck photograph of a contracted colony of *P. rica* (see Kott 2001: pl. 6g), is not present in the present species, and the sub-surface spicule layer of *P. rica* is thicker than the one in the present species. Furthermore, *P. rica* has a central test core (that, in the present species, appears to be represented by strands of test), its atrial lip is usually conspicuous and its spicules are larger and less regularly stellate than in the present species.

In their large open, common cloacal cavities, and their rectangular thoraces, colonies of this species resemble

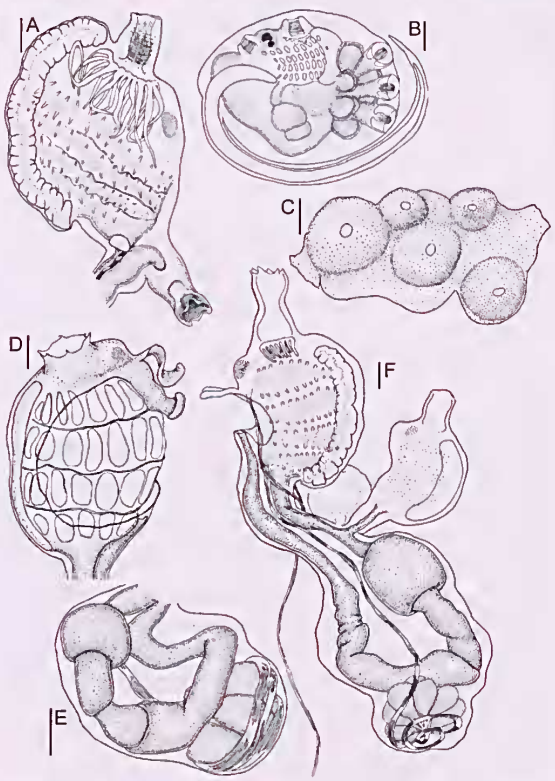

Fig. 5. *Leptoclinides brandi* (QM G308740): **A**, thorax. *Leptoclinides constellatus* (QM G308594): **B**, larva. *Polysyncraton alinguum* sp. nov. (NTM E310 holotype): **C**, colony; **D**, thorax; **E**, abdomen. *Polysyncraton arvum* sp. nov. (NTM E289 holotype): **F**, zooid. Scale bars, **A**, **B**, **D-F**, 0.1 mm. **C**, 5.0 mm.

some *Lissoclinum* spp., although the coiled vas deferens readily distinguishes them. As well as *P. rica*, *P. jugosum* Herdman and Riddell, 1913 and *P. pedunculatum* Kott, 2001 have similar common cloacal systems. Also, like the present species, they have four coils of the vas deferens, long retractor muscles and both are known only from temperate locations. However, *P. pedunculatum* is aspiculate and, although *P. jugosum* has a similar spicule distribution to the present species, the spicules are larger and have fewer spicule rays than the present species.

The species name is derived from the absence of an atrial lip from many of the zooids (lingua, n.=a tongue-shaped body).

Polysyncraton arvum sp. nov.

(Figs 5F; 20C; 22D)

Distribution. *Type locality*: Ashmore Reef, eastern side of entrance to West Lagoon 3–5 m, coll. K. Gowlett-Holmes, 10 October 2002, holotype NTM E289.

Description. The holotype is a firm, fleshy sheet which, viewed from the surface, appears as a mosaic of regular, spicule-filled slight elevations separated by narrow shallow depressions over the circular common cloacal canals which are lined on each side by zooids. A conspicuous, spicule-free superficial bladder cell layer contains some particles of brown pigment that are especially crowded in the depressions over the common cloacal canals. Common cloacal canals are deep, extending the full depth of the zooid. Spicules are crowded in a continuous thin layer (that includes the roofs of the common cloacal canals) beneath the superficial bladder cell layer, at branchial siphon level where they are concealed beneath crowded pigment particles. Spicules are not present in other parts of the colony. They are robust and stellate, to 0.09 mm diameter, with 11–17 short crowded conical rays in optical transverse section. Sometimes the rays are irregular and appear to be subdividing.

Zooids have a long trumpet-shaped branchial siphon with a basal constriction separating it from the anterior end of the remainder of the thorax. The atrial aperture is a large sessile opening with a bifid tongue of various sizes, often with its two branches of different lengths. The thorax is large with delicate longitudinal muscles that join a long, fine retractor muscle that extends from the top of the relatively long oesophageal neck, but is not readily detected. Several oesophageal buds are present. Ten stigmata are in the anterior row on one side of the branchial sac. The gut loop is vertical, with a barrel shaped clump of about ten unusally short testis follicles around which the vas deferens makes three turns. The vasa efferentia are longer than usual, compensating for the short male follicles. The larva is not known.

Remarks. The present species appears to be new, and although the form of its spicules and common cloacal systems resemble some others in this genus, it is characterised by its unusual, and relatively numerous, short testis follicles, few coils of the vas deferens, long branchial siphon and particularly large spicules in a thin layer at branchial siphon level. Other species with similar common cloacal systems, spicule shape and numbers of male follicles are the tropical *Polysyncraton purou* C. and F. Monniot, 1987 (which has smaller spicules and often is aspiculate), and the temperate *P. palliolum* Kott, 2001 (with smaller spicules distributed throughout the colony and more vas deferens coils) and *P. robustum* Kott, 2001 (which, although it sometimes is aspiculate, generally has, like the present species, spicules in a layer beneath the superficial bladder cell layer, although they are smaller than the spicules of the present species).

The species is named for the appearance of its colony surface which is broken up into a mosaic of fields (arvus, -a, -um=ploughed).

Polysyncraton niveum sp. nov.

(Figs 6A–D; 20D; 22E, F)

Distribution. *Type locality*: Ashmore Reef, West Lagoon, reef at start of inner channel 3–6 m, coll. K. Gowlett-Holmes, 30 September 2002, holotype NTM E233; inner West Lagoon 3–6 m, coll. K. Gowlett-Holmes, 2 October 2002; paratype NTM E258. *Further record*: Northern Territory (Darwin, QM G308738).

Description. Colonies are firm, fleshy encrusting slabs. Part of the margin of the holotype is growing around onto its basal surface making the colony partially double-sided. The most conspicuous aspect of these colonies are the large (to about 2 cm maximum dimension) thin, white slightly irregular patches or flakes in the surface test made up of a single layer of crowded spicules beneath a superficial layer of bladder cells. They are separated from each other by spicule-free strips of gelatinous test over the deep (the full zooid depth) primary common cloacal canals. The spicule-free test over the common cloacal canals, through which zooids can be seen, contains black pigment particles. The white flakes have frayed and serrated edges where spicules line the branchial openings of the zooids along each side of the cloacal canals). Large circular common cloacal chambers at the junctions of some of the primary common cloacal canals are roofed over by a particularly thin, transparent layer of surface test with a relatively small sessile common cloacal opening in the centre. When pressure is applied to the preserved colony this roof of the common cloacal chamber is elevated into a low dome with the common cloacal aperture in the centre of the dome. Spicules are confined to the patches in the surface and and are not found in other parts of the colony. They are spherical, burr-like, to 0.07 mm diameter, with 17–19 separate but crowded, rounded or flat-tipped rod- or club-shaped rays in optical transverse section.

Zooids are small, with a relatively short oesophageal neck and a short branchial siphon but with a long, bifid atrial lip, the branches often very different lengths. A short retractor muscle extends from the top of the oesophageal

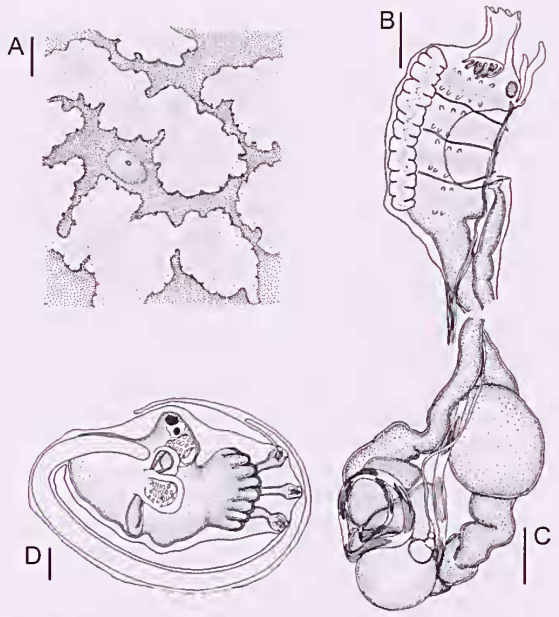

Fig. 6. *Polysyncraton niveum* sp. nov. (NTM E233 holotype): **A**, colony surface; **B**, thorax; **C**, abdomen; **D**, larva. Scale bars, **A**, 1.0 mm; **B-D**, 0.1 mm.

neck. Five or six testis follicles surrounded by three coils of the vas deferens are behind the zooid (against the dorsum of the ventrally flexed gut loop). The outside coil of the vas deferens loops around the large, yellowish egg, tending to constrict it off from the body wall. Larvae are in the basal test of the holotype colony. The larval trunk is 0.8 mm long and the tail is wound halfway around it. Eight ectodermal ampullae are each side of the three antero-median adhesive organs. A thoracic bud is on the right side of the larval oesophageal neck and two abdominal buds are on the left side.

Remarks. Superficially these colonies resemble *P. meandratum* C. and F. Monniot, 1987, with spicule-free areas around the common cloacal apertures and similar spicules. However, *P. meandratum* has pigmented zooids, a common cloacal aperture in the centre of a group of zooids (rather than at the junctions of canals), some of the globular spicules have slightly projecting pointed or chisel-shaped rays, spicules are smaller (never more than 0.05 mm diameter), the spicule layer is continuous over the roof of the common cloacal cavity, the vas deferens has only three coils and the larval trunk is half the size of the present species. *Polysyncraton dromide* Kott, 2001 (also Kott 2002) has similar colony and spicules but the spicules are smaller and are present over the common cloacal canals and often are absent from the zooid-free areas surrounded by them and the larvae are larger with more ectodermal ampullae. The newly described *P. arvum* has a colony superficially similar to the present one but its thin layer of spicules beneath the bladder cell layer is continuous over the common cloacal canals, its spicules are stellate with conical rays, it has more testis follicles of a different shape and only two vas deferens coils. *Polysyncraton adelon* F. and C. Monniot, 2001 has similar but smaller spicules crowded throughout the colony.

The thin, frayed patches of spicules beneath the superficial bladder cell layer appear to be unique to the present species and are the basis for its species name (niveus, -a, -um=snowy).

Didemnum albopunctatum Sluiter, 1909

(Figs 7A, B; 22G)

Didemnum albopunctatum Sluiter, 1909: 58. – Kott 2001: 148 and synonymy; Kott 2004a: 747; Kott 2004b: 2488.

Distribution. *Previously recorded* (see Kott 2001; 2004b):Western Australia (Rowley Shoals); Queensland (Great Barrier Reef); Indonesia; Fiji; New Caledonia; Palau Islands. *New records*: Ashmore Reef, NTM E236 E249; Western Australia (Houtman's Abrolhos, WAM 205.88); Indian Ocean (Cocos Keeling Islands, WAM 568.89).

Description. Colonies are hard encrusting light grey sheets crowded with small (less than 0.03 mm diameter) globular, burr-like spicules. Zooids of both newly recorded specimens from Ashmore Reef are a greenish-black colour that obscures their structure. Minute black pigment cells are mixed with the spicules in the surface test and in the upper half of the colony. Zooids have a large open atrial aperture, a long, straight retractor muscle projecting from halfway down the oesophageal neck and eight stigmata

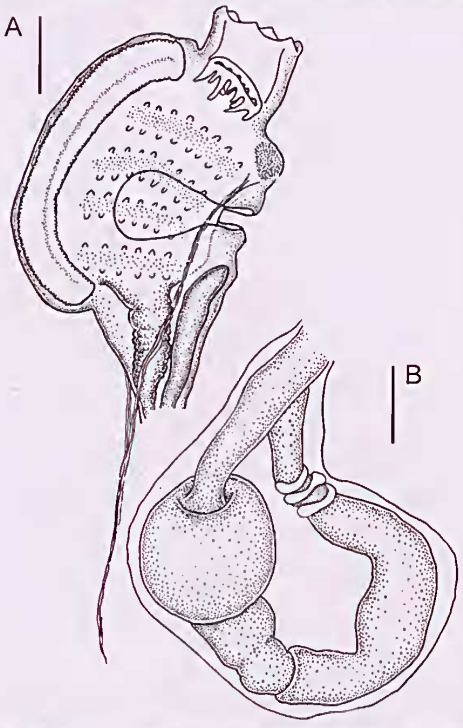

Fig. 7. *Didemnum albopunctatum* (NTM E249): **A**, thorax; **B**, abdomen, ventro-lateral (left) view. Scale bars, 0.1 mm.

in the anterior row and six in the posterior row of the branchial sac. Gonads were not detected in the newly recorded material.

Remarks. The characteristically small, globular, burr-like spicules of this species are unusual in the genus *Didemnum*. The new records are the first from north-western Australia for the species.

Didemnum aratore sp. nov

(Figs 8A, B; 20E, F; 22H)

Distribution. *Type locality*: Ashmore Reef, inner West Lagoon, 3–6 m, coll. K. Gowlett-Holmes, 2 October 2002, holotype NTM E256.

Description. The holotype is a thin, irregular scrap of a colony with a thin, transparent surface layer of test containing sparse spicules mixed with what appear to be plant cells, some single and others aggregated into spherical morulae. Spicules of a wide size range (to 0.97 mm diameter) are stellate to burr-shaped with 11–13 conical or rod-like to club-shaped rays in optical transverse section. The plant cells are spherical and translucent from about 0.01 mm or less to 0.085 mm diameter. Cells of a wide size range are aggregated into the morulae. Common cloacal cavities are extensive, isolating clumps of zooids embedded in the basal test from one another. A single layer of the spherical plant cells adheres around the thorax of each zooid.

Zooids are characteristic of *Didemnum* with a short branchial siphon divided into six lobes around the rim of the aperture. About six stigmata are in the anterior row on one side of the body. The gut forms a vertical loop. Oesophageal buds are present but gonads were not detected in the holotype.

Remarks. The species is distinguished by the sparse layer of spicules confined to the surface of the colony, and their form and wide size range. The spherical plant cells in the surface test, some single but others in aggregates and some forming a layer around the zooids, also are unique and, if found to be in obligate association with this species, a character that could be used for diagnostic purposes.

Known species in this genus in obligate association with embedded plant-cell symbionts are *D. etiolum* Kott, 1982, *D. herba* Kott, 2001, *D. verdantum* Kott, 2001 and *D. viride* (Herdman, 1906), which all have spicules with no more than nine rays in optical transverse section; *D.guttatum* F. and C. Monniot, 1996 which has large crowded spicules with 9 to 11 rays in optical transverse section; *D. poecilomorpha* F. and C. Monniot, 1996; and *D. flavoviride* Monniot, 1995 which has small burr-like spicules to 0.03 mm diameter, although, like the present species, its spicules are confined to the upper part of the colony.

The species is named for its plant cell symbionts (arator, -is, m.=gardener).

Didemnum clavum Kott, 2001

(Fig. 23A)

Didemnum clavum Kott, 2001: 162 and synonymy.

Distribution. *Previously recorded* (see Kott 2001): Western Australia (Buccaneer Archipelago, Legendre Island, Jurien Bay); Northern Territory (Darwin); Queensland (Heron Island, Swain Reefs); Indonesia. *New records*: Western Australia (off Port Hedland, WAM

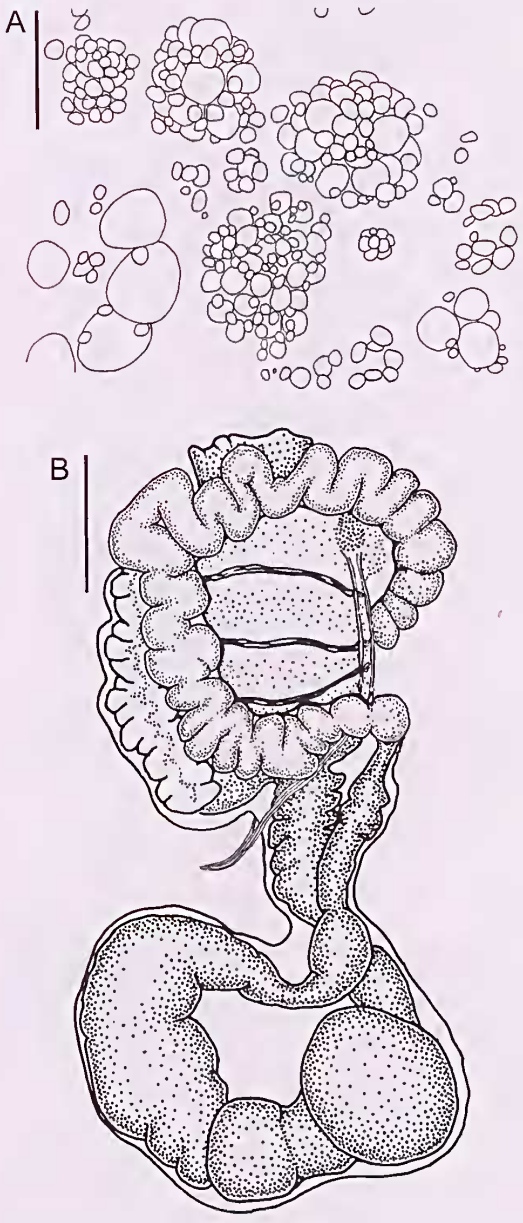

Fig. 8, *Didemnum aratore* sp. nov. (NTM E256 holotype): **A**, plant cells (?); **B**, zooid showing plant cells in a cylindrical shawl around the rim of the atrial aperture. Scale bars, 0.1 mm.

947.88); Northern Territory (Darwin Harbour, NTM E269; Bynoe Harbour, QM G308720, G308732).

Remarks. The newly recorded specimens have the characteristic spicules of moderate size, with five to seven long, narrow, pointed rays in optical transverse section, crowded throughout. The species appears to be a common component of the tropical aseidian fauna.

Didemnum domesticum sp. nov.

(Figs 9A–D; 20G, H; 23B)

Distribution. *Type locality*: Ashmore Reef, western side of entrance to West Lagoon, 4–7 m, coll. K.Gowlett-Holmes, 1 October 2002, holotype NTM E237. *Further record*: Northern Territory (Bynoe Harbour, Raft Point, QM G308710-1).

Description. The holotype is part of a robust encrusting sheet, crowded throughout with spicules. Evenly spaced stellate branchial apertures outlined in spicules are on the surface, and occasional low, rounded elevations around the margin of the colony have large, sessile long and narrow common cloacal apertures. Other slightly protuberant common cloacal apertures are slightly compressed at the anterior end of the more or less parallel amphipods lying on their dorsal surfaces in deep elliptical concavities that occur on much of the colony surface. These concavities are rounded anteriorly and pointed at the posterior end and are partially enclosed by the lateral margins of the concavity. The ventral appendages, especially the paired antennae, of each crustacean are exposed to the exterior just above the upper surface of the ascidian colony. The crustacean appears to have unusually bushy antennae (fide P. Davie) and possibly is filtering the water currents moving over the ascidian and entraining the excurrent water from the adjacent common cloacal apertures. This which would explain the parallel orientation of these commensals. Stellate branchial apertures are present in the concavities (as they are in the whole of the colony surface); presumably incurrent water entering the zooids from the water lying around the amphipod in what appears to be a closely fitting depression in the colony surface. The surface depressions appear to increase in size with the amphipods, which may be sessile, living permanently in the surface of the ascidian. The amphipod appears to be an undescribed species of the genus *Polycheria* Haswell, 1879, characterised by subchelate periopods that hold the organism in the surface of the ascidian host (fide J. Lowry).

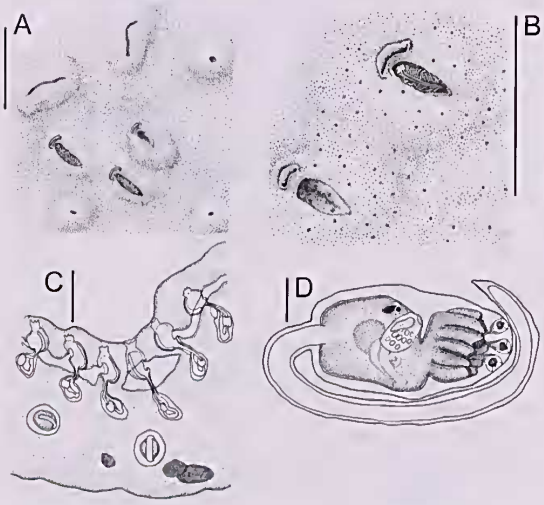

Fig. 9. *Didemnum domesticum* sp. nov. (NTM E237 holotype): **A**, colony surface showing common cloacal aperture and commensal amphipods; **B**, commensal amphipods depressed into colony surface adjacent to common cloacal apertures; **C**, cross section of colony showing thoracic common cloacal cavity and larvae in basal test. **D**, larva; Scale bars, **A**, **B**, 5.0 mm; **C**, 0.5 mm; **D**, 0.1 mm.

The common cloacal cavity is at thorax level, and the surface elevations around the margins of the colony are created by thickenings in the basal test. Spicules are crowded throughout the colony. They are stellate, to 0.04 mm diameter with seven to nine and sometimes five relatively long rays in optical transverse section. The rays are sometimes conical but many have an almost cylindrical basal part.

Zooids are small. A short branchial siphon has six sharp points around the rim of the aperture. Only six stigmata are in the anterior row. The thoracic musculature is delicate and a fine retractor musele extending from halfway down the long oesophageal neck is inconspicuous and hard to detect. The atrial opening is sessile, exposing the branchial sac directly to the common cloacal cavity. Abdomina are embedded in the basal test. The gut-loop either is vertieal or curved ventrally. Six coils of the vas deferens surround an undivided testis and a large yellow egg is at the posterior end of the zooid. Each zooid appears to have only one vascular stolon.

Larvae are present in the basal test. The larval trunk is small (about 0.5 mm long) and dark (with dark cells in the larval haemocoele) and the tail wound three-quarters of the way around it. Five long parallel finger-like ampullae are along each side of the three antero-median adhesive organs.

Remarks. The species is distinguished principally by its larvae with five pairs of ectodcrmal ampullae, together with six coils of the vas deferens and relatively few stigmata. The other species known to have five larval ampullae per side is *D. fuscum* Sluiter, 1909, which also has a similar sized larval trunk, dark cells in the larval haemocoele, and relatively few stigmata. However, it has nine coils of the vas deferens and much larger spicules than the present species. *Didemnum mantile*

Kott, 2001 is a temperate species with similar spicules distinguished from the present species by its common cloacal systems of circular canals over clumps of zooids, resulting in a quilted surface.

It is not known whether or not the crustaceans are obligate associates of this species. Nevertheless, the species name refers to the colony as a habitat for these commensals (domesticus -a -um=domestic).

Didemnum jedanense Sluiter, 1909

(Figs 10A, B; 23C)

Didemnum jedanense Sluiter, 1909: 59. – Kott 2001: 194 and synonymy.

Distribution. *Previously recorded* (see Kott 2001): Western Australia (Cape Ruthiers); Queensland (Hervey Bay, southern Great Barrier Reef, Abbott Point, Lizard Island, Low Isles, Mossman); Indonesia; New Caledonia. *New record*: Northern Territory (Darwin Harbour, Plater Rock, NTM E295).

Description. The newly recorded colony is a thin grey sheet. Spicules and small, spherical, dark pigment cells are mixed in a superficial bladder cell layer which meets with a white colony margin where the thick, crowded, layer of spicules in the basal part of the colony, which completely lacks pigment cells, is visible from the surface of the preserved colony. Sparse spicules mixed with pigment cells are present in the remainder of the colony. The common cloacal cavity is thoracic. Small spicules, rarely to 0.038 mm diameter, are burr-like and usually globular, although some are stellate with short conical rays.

Zooids are whitish, with a long straight retractor muscle, eight stigmata in the anterior row of the branchial sac and eight coils of the vas deferens. The abdomen is relatively large, with an ample gut loop. Large larvae (trunk 0.92 mm long), present in the basal test, have seven pairs of long, club-shaped lateral ampullae surrounding the three antero-median adhesive organs. An oozooid has a thoracic and an abdominal bud in the oesophageal region.

Remarks. *Didemnum* spp. with similar large larvae (containing numerous long, club-shaped lateral ampullae and blastozooids) generally have significantly larger spicules (*D. chartaceum* Sluiter, 1909), or spicules crowded in a raspy surface layer (*D. arancium* Kott, 2001, *D. levitas* Kott, 2001), or spicules crowded throughout the colony (*D. precocinum* Kott, 2001) or three-dimensional common cloacal systems (*D. dealbatum* Sluiter, 1909). The small burr-shaped spicules and large larvae with buds and numerous lateral ampullae of the present species, together with the arrangement of the zooids, presence of pigment in oval cells, the ample gut loop, and the layer of spicules in the basal test, are characteristic of this species, albeit sometimes its colonies are aspiculate.

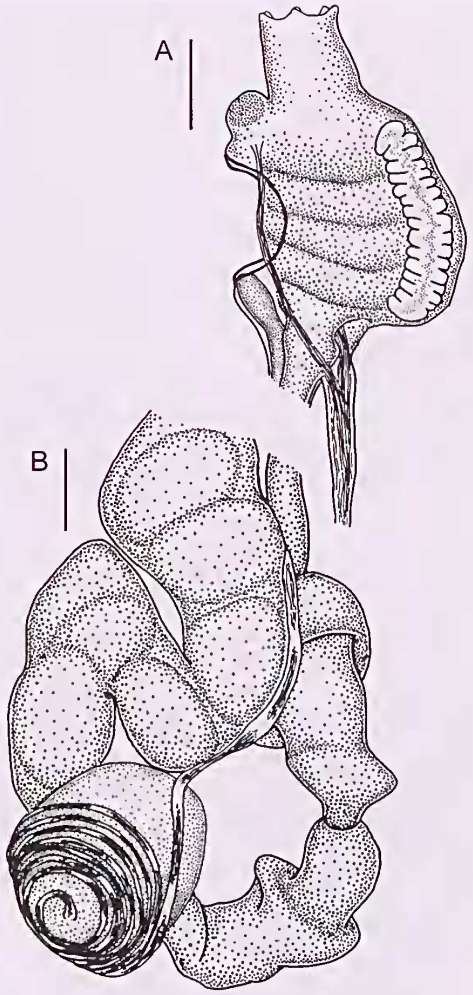

Fig. 10. *Didemnum jedanense* (NTM E295): **A**, thorax; **B**, abdomen, dorsal view. Scale bars, 0.1 mm.

Didemnum lillipution sp. nov.

(Figs 11A–C; 21A; 23D)

Distribution. *Type locality*: Ashmore Reef, inner West Lagoon, 3–6 m, coll. K. Gowlett-Holmes, 2 October 2002, holotype NTM E250.

Description. The holotype colony is a small, frayed fragment of a thin, brittle sheet. Spicules are crowded throughout. Stellate branchial apertures outlined in spicules are evenly spaced over the colony surface. Thoraces cross the deep thoracic horizontal common cloacal cavity, each either in an independent test sheath or with its ventrum embedded in a solid test connective between the thin surface and thicker basal test. Generally the abdomina are embedded in the basal test but occasionally they are in these test connectives, surrounded by deeper sections of the common cloacal cavities. Spicules have seven to nine long, conical (although not very pointed) rays with a long, almost rod-like shaft.

Generally spicules are up to 0.07 mm diameter, but occasional large spicules to 0.1 mm diameter occur. The ray length/spicule diameter ratio is 0.4 or more.

Zooids are very small, only about four stigmata being detected in the anterior row of the narrow branchial sac. Neither an atrial tongue nor a retractor muscle was detected. The vas deferens coils five times around the undivided testis. The small (trunk 0.05 mm long) larvae are being incubated in the basal test. They have three antero-median adhesive organs surrounded by four pairs of lateral ampullae and three rows of stigmata are in the larval pharynx. The tail is wound three-quarters of the way around the trunk.

Remarks. Zooids and larvae of this species are amongst the smallest yet recorded for the genus. The small larvae with their four pairs of lateral ampullae, three rows of stigmata and lacking blastozooids are commonly encountered in the genus. Similar, but significantly smaller, spicules with and relatively few short, rod-shaped rays are in the tropical *D. candidum* Savigny, 1816 (see Kott 2001) and *D. granulatum* Tokioka, 1954 and in the temperate species *D. delectum* Kott, 2001.

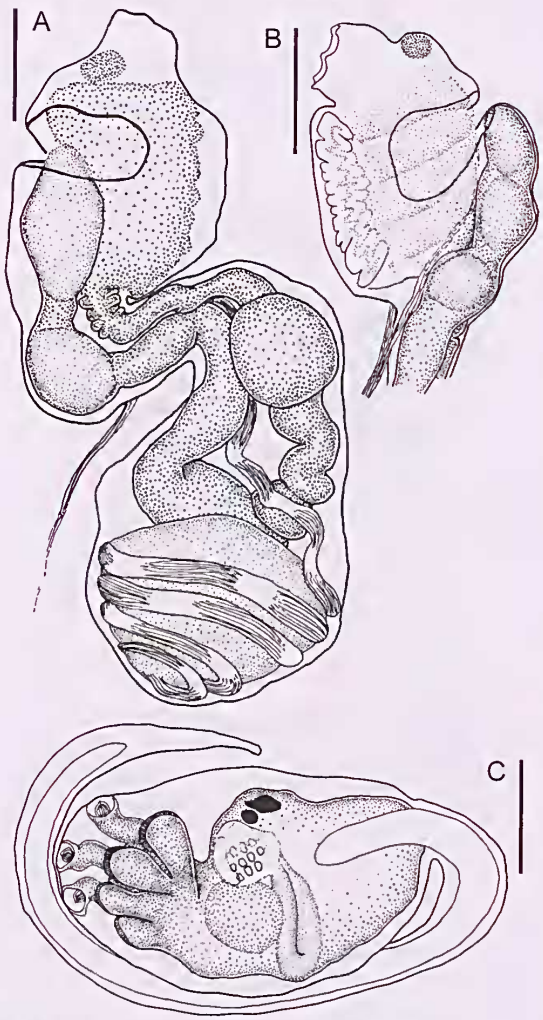

Fig. 11. *Didemnum lillipution* sp. nov. (NTM E250 holotype): **A**, zooid; **B**, thorax; **C**, larva. Scale bars, 0.1 mm.

The species name is from Lilliput, an imaginary land inhabited by miniature individuals (from *Gulliver's Travels,* by the 17–18th century Irish satirist, Jonathon Swift).

Didemnum madeleinae F. and C. Monniot, 2001

(Fig. 23E)

Didemnum madeleinae F. and C. Monniot, 2001: 268. – Kott 2002: 35; Kott 2004b: 2497.

Distribution. *Previously recorded* (see Kott 2002, 2004b): Northern Territory (Darwin, Channel Islands), Papua New Guinea. *New records*: Northern Territory (Darwin, NTM E293; Bynoe Harbour, QM G308712).

Remarks. The newly recorded colony has the usual characteristic, small, stellate spicules with relatively few (five to seven in optical transverse section) rays. Kott (2004b) has erroneously referred to seven to nine rays in optical transverse section. It is distinguished from others with similar spicules (see *D. granulatum*, above) by its relatively numerous (eight) coils of the vas deferens.

Didemnum membranaceum Sluiter, 1909

(Fig. 12A)

Didemnum membranaceum Sluiter, 1909: 58. – Kott 2001: 205 and synonymy.

Distribution. *Previously recorded* (see Kott 2001): Western Australia (Montebello Islands, Houtman's Abrolhos, Dongara); Queensland (Moreton Bay, Caloundra, Great Barrier Reef), Timor Sea, Andaman Islands, Indonesia, Micronesia, French Polynesia, Hong Kong. *New records*: Ashmore Reef, WAM 174.93, NTM E285; Western Australia (Shark Bay, WAM Z20558; Cockburn Sound, WAM 139.93).

The record from Cockburn Sound is the most southerly on the western Australian coast.

Description. The newly recorded colonies are the usual thin encrusting sheets with spicules crowded throughout and sometimes some minute crowded spicule-filled papillae crowded on some parts of the surface. Minute, inconspicuous, brown pigment cells are in the thin, aspiculate superficial layer of test and spicules project up through this layer around each branchial siphon. The pigment cells also are scattered amongst the spicules. Spicules have the usual characteristic stellate form with 9 to 11 pointed rays. Giant tetrahedral spicules with about six long needle-like rays are scattered amongst the other spicules. Branchial siphons are short. Six small, pointed lobes are around the rim of each aperture. Spicules line the margin of each stellate aperture on the surface of the colony. Small comma-shaped thoraces, with only six stigmata in the anterior row, cross the horizontal common

cloacal cavity in their independent test sheaths and a retractor muscle projects from about halfway down the oesophageal neck.

Remarks. This is one of the more commonly encountered Indo-west Pacific sheet-like didemnids. Owing to its characteristic mix of smaller stellate with giant spicules, it is relatively easy to distinguish it from others with spicules crowded throughout and papillae on some parts of the surface. Living specimens are some shade of orange or red.

Didemnum nekozita Tokioka, 1967

(Figs 12B–D; 23F, G)

Didemnum nekozita Tokioka, 1967: 67. – Kott 2004a: 754 and synonymy.

Distribution. *Previously recorded* (see Kott 2004a): Western Australia (Shark Bay); Queensland (Capricorn Group, Lizard Island); Palau Islands, French Polynesia, Philippines, Fiji, Eniwetak. *New records*: Ashmore Reef, NTM E238 E272: Western Australia (Houtman's Abrolhos, WAM 178.93).

Description. Several of the new records are of some small fragments of colonies, but a specimen from Ashmore Reef is a more extensive white sheet. The sheet-like colony has depressions in the surface over deep primary common cloacal canals which are the full depth of the zooids and have zooids arranged along each side. Zooid openings are not always conspicuous, sometimes having the surrounding test crowded with spicules rather than only having the margins of the stellate openings lined with them. Common cloacal apertures are at the junctions of some of the canals have aspiculate, transparent rims. Zooids have relatively large thoraces with eight stigmata in the anterior row of the branchial sac. A large sessile atrial opening exposes the stigmata directly to the common cloacal cavity. A retractor muscle projects from about halfway down the long oesophageal neck. The abdomina are relatively large in this species and the gut is voluminous and forms a double loop. The broad proximal half of the rectum narrows abruptly to the distal half, which is a narrow straight tube. The part of the loop (behind the duodenum) is where the loop bends ventrally and a patch of pigmented granular material is always in the body wall where this bend occurs, the bend itself making the patch U-shaped in longitudinal section. Two conspicuous, but not especially long, vascular stolons with tear-drop-shaped terminal ampullae project from the ventral concavity of the abdomen where it bends ventrally. The vas deferens coils seven times around the entire testis.

Remarks. The identification is based on the characteristic small (less than 0.03 mm diameter), stellate spicules with seven to nine blunt-tipped rays with straight almost rod-shaped shafts and some giant spicules with relatively few (often only six) long, pointed rays. The U-shaped patch of dark granular material in the bend of the voluminous gut loop appears to be characteristic of this species. The surface papillae and the small rounded cushion-like colonies sometimes reported for the species (see Tokioka 1967; Kott 2001) probably are variable.

The species can be expected to occur in coralline habitats in the Indo-west Pacific.

Didemnum ossium Kott, 2001

Didemnum ossium Kott, 2001: 216 and synonymy. – Kott 2004a: 756.

Distribution. *Previously recorded* (see Kott 2001, 2004a): Western Australia (Montebello Islands, Bonaparte Archipelago, Lord Mayor's Shoal, Passage Islands); Northern Territory (English Company's Island); New Caledonia; Philippines. *New record*: Western Australia (42 n miles N of Port Hedland, WAM122.93).

Remarks. The species is one of a group with more than one type of spicules. It has stellate ones with conical pointed rays, others with blunt rays as well as more globular spicules with stumpy, flat-topped projections around the surface. The spicules are characteristically moderate-sized (to 0.06 mm) and the stellate ones have 11–13 relatively long and sharply pointed rays in optical transverse section. The

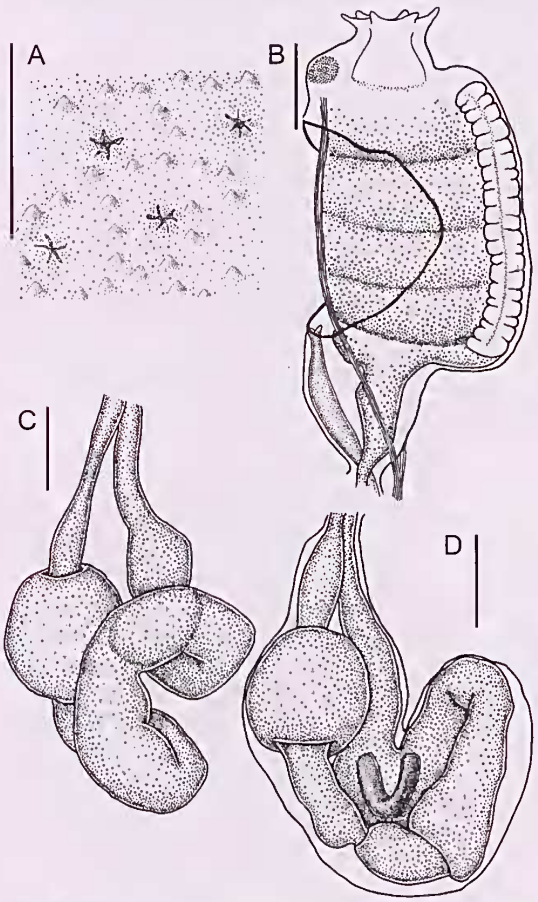

Fig. 12. *Didemnum membranaceum* (NTM 285): **A**, colony surface. *Didemnum nekozita* (NTM E272): **B**, thorax; **C**, **D**, abdomina. Scale bars, **A**, 1.0 mm; **B–D**, 0.1 mm.

latter are larger and their rays longer and more sharply pointed than the spicules of *D. moseleyi* (Herdman, 1886). *Didemnum bicolor* Kott, 2001 and *D. diffundum* Monniot, 1995 (see Kott 2001) have smaller spicules (to 0.03 mm diameter) and *D. macrosiphonium* Kott, 2001 is a temperate species with a long branchial siphon and spicules with fewer (9–11) rays. *Polysyncraton millepore* Vasseur, 1969 is distinguished by it generic characters as well as its distinctive biscuit-like colony and unique atrial tongue (see Kott 2001, 2004a).

The new record is the most southerly location recorded for this species.

Didemnum roberti Michaelsen, 1930

Didemnum roberti Michaelsen, 1930: 516. – Kott 2001: 230 and synonymy; Kott 2004a: 758.

Distribution. *Previously recorded* (see Kott 2001, 2004a): Western Australia (Rottnest I, Port Hedland, Shark Bay, Montebello Islands, Bonaparte and Dampier Archipelagoes); Northern Territory (Parry Shoals, Gulf of Carpentaria, Bathurst Island). *New records*: Western Australia (Montebello Islands WAM 156.93, Cape Preston WAM 170.93); Northern Territory (Bynoe Harbour, QM G308717, G308725, G308727, G308733).

Remarks. Colour variations previously recorded for this conspicuous northern Australian species are shown in Kott (2001: Pl. 14e–h) and include large lobed colonies flecked with red, cream colonies with byellow pigment around the apertures, and black pigment crowded on the top of the lobes. Similar colonies flecked with black rather than red are reported from the Montebello Islands (Kott 2004a) and in a newly recorded specimen from Bynoe Harbour (QM G308717) and the other newly recorded colonies are cream coloured with yellowish pigment around the common cloacal apertures, Despite this variation in colour, the species is readily identified by the sharply pointed rays of its stellate spicules.

Didemnum rota sp. nov.

(Figs 13A, B; 21B; 23H)

Distribution. *Type locality*: Ashmore Reef, western side of entrance to West Lagoon, 4-7 m, coll. K.Gowlett-Holmes, 1 October 2002, holotype NTM E241.

Description. The preserved colony is an irregular, white, encrusting sheet with dimples where the branchial apertures are contracted into the surface. The surface has a fluffy appearance owing to the stellate spicules embedded close to the surface in the superficial layer of test. Spicules are crowded throughout the colony. The common cloacal cavity is a shallow, horizontal space at thorax level. Spicules are to 0.07 mm diameter and have five to seven and sometimes nine long rays, with an almost cylindrical shaft that converges to a terminal point. The ray length/spicule diameter ratio is about 0.375.

The zooids have a strong retractor muscle from halfway down the oesophageal neck. The vas deferens coils seven times around the undivided testis. Larvae are not known.

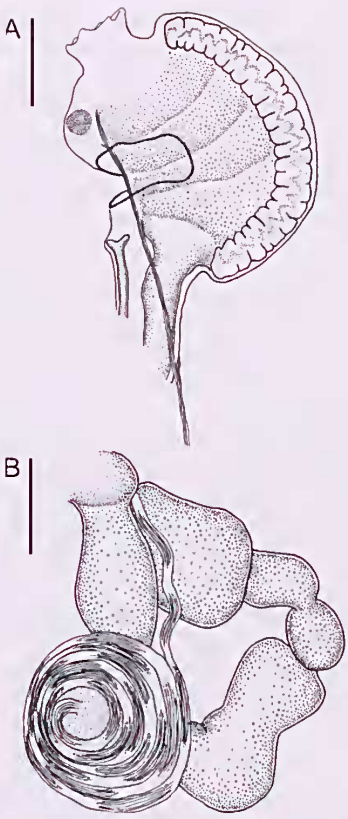

Fig. 13. *Didemnum rota* sp. nov. (NTM E241): **A**, thorax; **B**, abdomen. Scale bars 0.1 mm.

Remarks. Tropical species with similar spicules having relatively straight shafts with terminal points are: *D. fuscum* Sluiter, 1909 (distinguished by its dark test cells around the zooids, larger spicules and more vas deferens coils), *D. nekozita* Tokioka, 1967 (distinguished by its smaller spicules with fewer rays, giant spicules with few long, spiky rays and larger zooids with conspicuous vascular stolons), *D. coralliforme* Kott, 2004b (distinguished by its larger spicules with more attenuated points), *D. grande* (Herdman, 1886) (again with larger spicules with more attenuated rays but also conspicuous depressions in the surface test over the primary common cloacal canals) and *D. granulatum* Tokioka, 1954 and *D. candidum* Savigny, 1816 (both with smaller spicules). *Didemnum lillipution* sp. nov. (see above) has similar but larger spicules and smaller zooids with fewer stigmata and vas deferens coils than the present species.

The species name refers to the straight, rod-like spicule rays like the spokes of a wheel (rota, -ae=wheel).

Didemnum tumulatum sp. nov.

(Figs 14A–C; 21C; 24A)

Distribution: *Type locality*: Ashmore Reef, 6–8 m, coll K. Gowlett-Holmes, 5 October 2002, holotype NTM E279.

Description. The holotype colony is an irregular, lumpy mass, encrusting weed. Small, rounded elevations

on the surface have terminal common cloacal apertures and have central cores of test (continuous with the basal test) which are separated from the surface zooid-bearing layer of test by a posterior abdominal common cloacal cavity that extends up around clumps of zooids, isolating them from each other. Thoracic common cloacal cavities penetrate in amongst the thoraces in each clump. Spicules are in a crowded layer in the surface test but are relatively sparse elsewhere. They are of moderate size (0.06 mm diameter) and have 9 to 11 long conical rays.

Zooids are small. A retractor muscle projects out from near the top of the oesophageal neck and there are seven coils of the vas deferens around a conical testis. Larvae are not known.

Remarks. The species has similar common cloacal systems to *D. fragum* Kott, 2001 (distinguished by its larger colony lobes, 12 vas deferens coils and larger spicules crowded throughout) and *D. spongioide* Sluiter, 1909 (distinguished by its larger colonies and larger spicules with fewer rays also crowded throughout the colony). *Didemnum roberti* Michaelsen, 1930 has larger colony lobes and spicules with fewer and more pointed rays and *D. pecten* Kott, 2001 has shorter and more conical spicules rays and nine coils of the vas deferens. Both these species have similar three-dimensional common cloacal cavities as the present one although, unlike the present species, their spicules are confined to a layer in the upper part of the colony.

The species is named for the conical elevations of the colony surface (tumulus, -i=hill).

Didemnum usitatum sp. nov.

(Figs 15A, B; 21D; 24B)

Distribution. *Type locality*: Ashmore Reef, eastern side of entrance to West Lagoon, 4–6 m, coll. K. Gowlett-Holmes, 2 October 2002, holotype NTM E259.

Description. The holotype colony is firm, thin and encrusting. It is crowded with spicules throughout and the surface is covered with minute spicule-filled papillae. The common cloacal cavity is shallow and horizontal, at thorax level. Abdomina are embedded in thick basal test. Spicules are small (to 0.045 mm diameter) and stellate with 9–11 robust, pointed, conical rays in optical transverse section.

Zooids are small with a straight retractor muscle from halfway down the oesophageal neck. The vas deferens coils six times around the lens-shaped undivided testis. Larvae are not known.

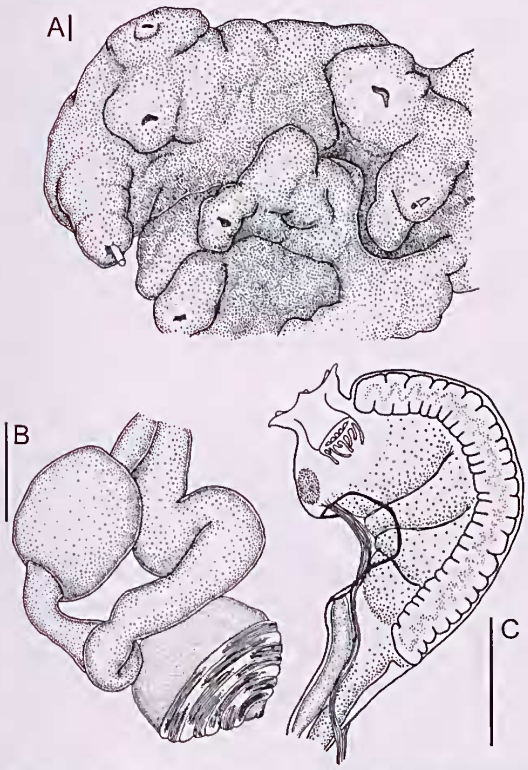

Fig. 14. *Didemnum tumulatum* sp. nov. (NTM E279 holotype): **A**, colony; **B**, abdomen, ventral view; **C**, thorax. Scale bars, **A**, 1.0 mm; **B**, **C**, 0.1 mm.

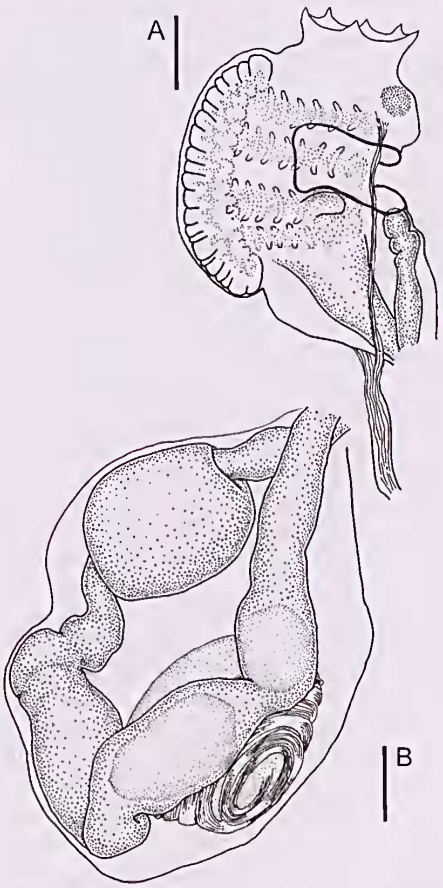

Fig. 15. *Didemnum usitatum* sp. nov. (NTM E259 holotype): **A**, thorax; **B**, abdomen. Scale bars, 0.1 mm.

Remarks. The flat, encrusting, spicule-filled colony of the present species, with minute papillae on the surface and regularly stellate spicules, resembles many other species in this genus, including *D membranaceum*. Its zooids are larger, the spicules are smaller and it lacks the giant spiky spicules of *D. membranaceum*. The tropical *D. caesium* Sluiter, 1909 and the temperate *D. sucosum* Kott, 2001 have similar but larger spicules. *Didemnum via* Kott, 2001 also has similar but larger spicules with longer and narrower rays, brown pigment in a superficial layer of test and the surface depressed over deep primary common cloacal canals. Spicules also are similar to those of the newly described species, *D. tumulatum* (see above), although the common cloacal canals are different, posterior abdominal canals being present in the latter species, spicules are sparse in the middle layers of the colony and it has more coils (eight) of the vas deferens than the present species.

The species has characters in common with many other species, a fact reflected in its name (usitatus, -a, -um=usual, customary).

***Didemnum vesperi* sp. nov.**

(Figs 21E, F; 24C)

Didemnum lacertosum – F. and C. Monniot 2001: 268.

Not *Didemnum lacertosum* Monniot, 1995: 311.

Distribution. *Type locality*: Ashmore Reef, western side of entrance to West Lagoon, 4–7 m, coll. K. Gowlett-Holmes, 1 October 2002, syntypes NTM E239.

Description. In preservative the syntypes are small, thin, white irregular colonies but the living specimens are small rounded cushions, 1–2 cm in maximum extent, with spicules crowded throughout. Living specimens are mauve or purple with a white star in the centre of the colony where the common cloacal aperture is surrounded by pigment-free test and the white spicules in the base of the colony can be seen through the open aperture. The common cloacal cavity is thoracic and abdomina are embedded in the basal test. Spicules, to 0.056 mm diameter, are a mixture of stellate spicules with 13–17 crowded relatively short, conical, blunt-tipped rays and globular ones with flat-tipped rod-like rays. Zooids are minute with no more than six stigmata in the anterior row on one side. A small retractor muscle extends from the top of the oesophageal neck. The gut forms a simple loop and the vas deferens coils eight times around the undivided testis. Larvae are not present in the syntypes but are present in material from Papua New Guinea (*D. lacertosum*: F. and C. Monniot 2001) which appears to be conspecific. These larvae have a trunk 0.55 mm long, 8–10 ectodermal ampullae and blastozooids.

Remarks. The photographed living specimens look identical to those of *D. lacertosum*: F. and C. Monniot, 2001 from Papua New Guinea. They do not appear to be conspecific with the type material of *D. lacertosum* Monniot, 1995 (from the Loyalty Islands), which, although the appearance of the living colonies is not recorded, has smaller spicules with more rays than the present species and only six to eight larval ectodermal ampullae. The spicules of the present species resemble those of *D. moseleyi* (Herdman, 1886) and *D. nambuccense* Kott, 2004a. The types of the former species are colonies to 5 cm in maximum extent although Kott (2001) later assigned larger sheets to the species. Although its spicules are much the same size as the present species, they have fewer rays (to 11 in optical transverse section). Larval forms that can be confidently assigned to *D. moseleyi* have not yet been described (see Kott 2001). *Didemnum nambuccense* is a temperate species from New South Wales with more spicule rays (17–19) and its zooids are larger than the present species and dark brown.

The species name refers to the purple-blue colour of the colonies, each with a large white star in the centre of the upper surface (vesperi, -i=the evening star).

***Tridemnum discrepans* (Sluiter, 1909)**

(Fig. 16A, B)

Leptoclinum discrepans Sluiter, 1909: 77.

Tridemnum discrepans – Kott, 2001: 267 and synonymy; Kott 2004a: 761 and synonymy.

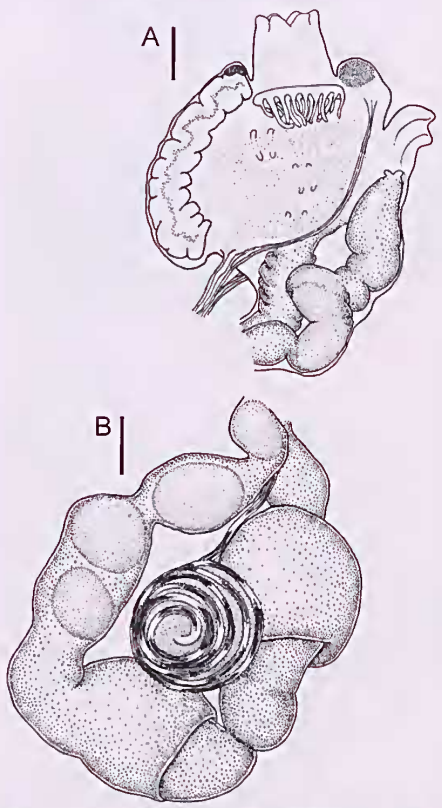

Fig. 16. *Tridemnum discrepans* (NTM E251): **A**, thorax; **B**, abdomen, ventral view. Scale bars, 0.1 mm.

Distribution. *Previously recorded* (see Kott 2001, 2004a): Australia (north-western, north-eastern and southern Australia, Torres Strait), Indonesia, New Caledonia, Philippines, Fiji, Palau Islands, Kiribati, Tonga, Thailand, Cocos Keeling Islands. *New records*: Western Australia (Rowley Shoals, WAM 183 93; Ashmore Reef, NTM E251).

Description. The newly recorded specimens are black, gelatinous cushions with a whitish translucent undersurface. The pigment is in filamentous strands through the upper half of the colony, especially in the surface and gathered into a black patch over each of the large zooids. An endostylar pigment cap is at the anterior end of the endostyle. Large common cloacal canals run through the upper half of the colony. The vas deferens coils seven times around the testis follicle.

Remarks. The species is distinguished by its black gelatinous colonies, filamentous pigment particles, lack of spicules and large larval trunk with six pairs of ectodermal ampullae. The present specimens lack larvae but previously recorded ones (Kott 2001, 2004a) have a trunk to 1.1–1.4 mm long. Kott's (2001) report that *Trididemnum savignii* has a smaller larval trunk than the present species appears to have been unfounded, as the larva of this species is not yet reported. *Trididemnum marmoratum* (Sluiter, 1909) has oval to spherical pigment cells (rather than the filamentous strands of the present species) and similar sized larvae but they have eight long ectodermal ampullae per side (see Kott, 2002 and below). *Trididemnum dispersum* (Sluiter, 1909) has similar but smaller colonies and distinctive stellate spicules.

Trididemnum farrago sp. nov.

(Figs 17A, B; 21G, H; 24D)

Distribution. *Type locality*: Ashmore Reef, inner West Lagoon, 3–6m, coll. K.Gowlett-Holmes, 2 October 2002, holotype NTM E253.

Description. The colony is a thin, brittle, encrusting sheet, white in preservative, with large (to 0.09 mm diameter) stellate spicules crowded throughout. The upper surface is smooth and white, being interrupted by evenly spaced zooid openings. The spicules have from 7 to 15 pointed rays of varying lengths in optical transverse section, the spicule outline often being irregular rather than regularly stellate. The rays vary from being short and conical to long and attenuated. Common cloacal cavities are shallow, horizontal spaces at thoracic level.

Zooids are very small and in the holotype they are contracted and withdrawn from the surface. The contracted zooids have a short atrial siphon projecting from the posterior third of the dorsal surface of the thorax and a short retractor muscle from the posterior end of the thorax. They have mature testes and probably are protandrous. The vas deferens is coiled six times around the undivided testis. Oesophageal buds are present. Larvae are not known.

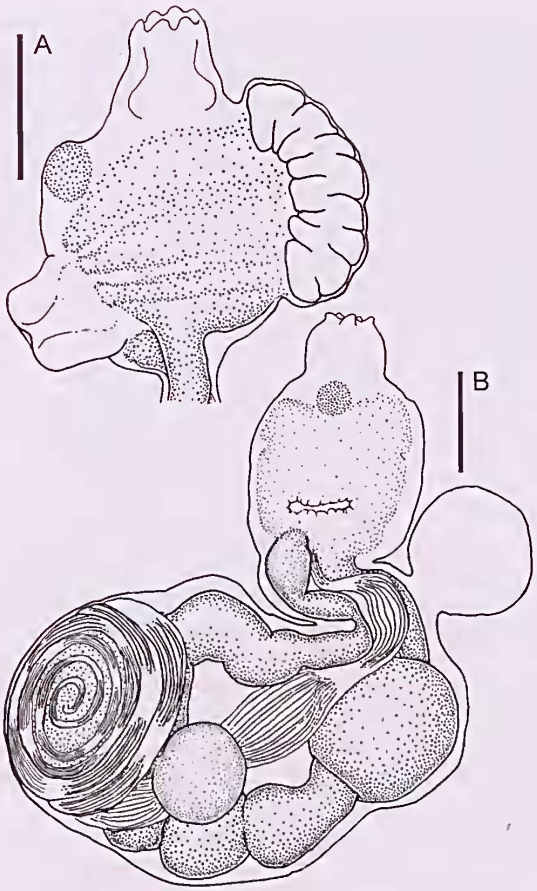

Fig. 17. *Trididemnum farrago* sp. nov. (NTM E253 holotype): **A**, thorax; **B**, zooid. Scale bars, 0.1 mm.

Remarks. The thin, brittle colony with a thoracic common cloacal cavity, unique and relatively large, irregular spicules with an unusually large range in the number of rays (7–15 in optical transverse section) crowded throughout and the small zooids are characteristic of this species. It lacks the dark pigment often found at the anterior end of the thorax in species of the *savignii* group in this genus (see Kott 2001).

The irregular spicules with rays of various lengths are the basis for the species name (farrago, -inis=a mixture).

Trididemnum marmoratum (Sluiter, 1909)

(Fig. 24E)

Leptoclinum marmoratum Sluiter, 1909: 84.

Trididemnum marmoratum – Kott 2002: 38.

Distribution. *Previously recorded* (see Kott 2002): Northern Territory (Gulf of Carpentaria), Indonesia. *New record*: Northern Territory (Darwin, NTM E294).

Description. The newly recorded colony is a firm slab with the surface raised into rounded swellings with terminal common cloacal apertures. Spicules are present

in a layer at thorax level beneath the superficial layer of bladder cells. They are sparse in the remainder of the test, except for a layer in the base of the colony. They are also present in appreciable concentrations around the common cloacal cavities, which are at oesophageal and posterior abdominal levels. The spicules in the newly recorded colony are stellate, to 0.075 mm diameter, with 9–11 conical pointed rays in optical transverse section. Black squamous epithelium is present on some of the zooids in the newly recorded specimen, although an endostylar pigment cap was not detected. Zooids are not readily removed from the test in this species. Faecal pellets are crowded into patches in the basal test.

Remarks. The differences between this species, *T. pseudodiplosoma* and *T. planum* are documented below (see *T. planum*, Remarks). *Trididemnum savignii* (Herdman, 1886) and *T. areolatum* (Herdman, 1906) have similar gelatinous colonies but larger spicules, and the aspiculate *T. discrepans* (Sluiter, 1909) also has gelatinous colonies although these species have branched and filamentous pigment cells crowded in amongst the bladder cells in the test that are different from the oval to spherical cells that sometimes occur in the present species, *T. pseudodiplosoma* and *T. planum*. *Trididemnum sibogae* (Hartmeyer, 1910), another related species with oval-spherical pigment cells, is distinguished by its larger spicules and complex colony. These species are also distinguished from one another by having different numbers of larval lateral ampullae.

Although gonads are not developed in the newly recorded colony of *T. marmoratum*, Monniot (1994) has reported six vas deferens coils for this species. This also distinguishes it from the species compared with it above, all of which have eight coils of the vas deferens.

Trididemnum planum Sluiter, 1909

(Fig. 18A)

Trididemnum planum Sluiter, 1909: 42. – Kott 2001: 256; Kott 2002: 39.

Distribution. *Previously recorded* (see Kott 2002): Northern Territory; Indonesia. *New records*: Northern Territory (Bynoe Harbour, QM G308680, G308681, G308683).

Description. Colonies are sheet-like and grey to black, with an irregular surface or they are more complex cushions with lobes overgrowing the surface and one another to form a three-dimensional reticulum. Minute irregular to spherical black pigment particles are in the surface test, either evenly distributed or in patches and/or streaks. Some colonies have patches of spicules in the surface test mixed with the pigment particles or interrupting them. Spicules also are in a crowded layer in the floor of the common cloacal cavity, which has deep primary canals and shallower secondary canals at oesophageal level. Spicules generally are absent from the thick basal layer of test, which is only rarely traversed by posterior abdominal common cloacal canals and they are completely absent from the base of the colony. Spicules are stellate, to 0.06 mm diameter, with 13–15 short conical rays in optical transverse section.

Zooids are covered with black squamous epithelium. Thoraces are small and rounded, with a black endostylar pigment cap at the top of the endostyle. The black squamous epithelium is interrupted by the circular concavity of the lateral organs on each side of the posterior end of the thorax near the base of the short posteriorly directed atrial siphons. A short retractor muscle projects from the posterior end of the thorax (at the top of the oesophageal neck). About 12 stigmata are in the anterior of the three rows in the branchial sac and conspicuous unperforated areas are anterior and posterior to the stigmata. The gut loop is long and forms a double loop. The testis is against the flexed part of the loop at the posterior end of the zooid and is surrounded by eight coils of the vas deferens.

Large elliptical larvae have a trunk 1.4 mm long with five ectodermal ampullae along each side of the three long-stalked antero-median adhesive organs are in the basal test. A large spherical mass of yolk is in the centre of the trunk in front of the vertical gut loop. Large spherical bladder cells are crowded in the larval test.

Remarks. The species varies in the intensity and distribution of pigment in the superficial bladder cell layer, colony form and the distribution of patches of spicules in the surface test. However, the layer of spicules in the floor of the relatively shallow common cloacal cavity, the size and form of the spicules, the numbers of vas deferens coils and larval lateral ampullae and especially the large bladder cells crowded in the larval test are all characteristic of this species. The posterior end of the larval trunk observed in the present specimen (QM G308681) appears to have been drawn out as it was removed from the colony, an artefact that probably explains why it is larger than has been recorded previously for this species (Kott 2002).

The black patches and streaks of crowded oval to spherical pigment cells are found also in preserved colonies of *T. marmoratum* and *T. pseudodiplosoma*. Black squamous epithelium and the endostylar pigment cap are found in the present species and in *T. marmoratum*; and eight coils of the vas deferens are present in the present species and in *T. pseudodiplosoma* while *T. marmoratum* has only six coils of the vas deferens. There are some differences in the spicules of *T. planum* and *T. marmoratum*, and *T. pseudodiplosoma* is largely aspiculate, but these three species are most readily separated by the number of larval ampullae, *viz.* five pairs in *T. planum*, eight pairs in *T. marmoratum*, and 12 or more pairs in *T. pseudodiplosoma* (which also has up to eight blastozoods).

***Trididemnum pseudodiplosoma* (Kott, 1962)**

(Figs 18B; 24F)

Didemnum pseudodiplosoma Kott, 1962: 321.

Trididemnum pseudodiplosoma – Kott 2001: 279 and synonymy; Kott 2004b: 2504.

Trididemnum crystallinum Kott, 2001: 263 (new synonym).

Distribution. *Previously recorded* (see Kott 2001 and 2004b): South Australia; Northern Territory; Coral Sea. *New records*: Northern Territory (Bynoe Harbour, QM G308679, G308682, G308706, G308723; Darwin Harbour, NTM E298, NTM E314, E315).

Description. Except for one specimen from Darwin Harbour, the newly recorded colonies are all aspiculate. One (QM G308679) is translucent and irregular and has only few oval brown pigment particles with parts of the surface overgrowing other parts to form a complex three-dimensional colony. The others (QM G308682, G308723, NTM E314-5 and NTM E298) are either grey-black in preservative or the black pigment particles are distributed in patches or streaks and sometimes are concentrated in the branchial lobes. One grey-black colony (QM G308682) is primarily sheet like but has some surface furrows and ridges and the others are the usual complex three-dimensional shapes. Bladder cells are present throughout the test. Burr-like spicules with rod-like rays and a few stellate spicules to 0.045 mm diameter are sparsely distributed in a single layer in a few patches just beneath the superficial layer of test in the newly recorded specimen from Darwin Harbour (NTM E298).

Zooids are characteristically large, with a branchial siphon of moderate length, but the atrial siphon is short and projects only slightly from the posterior end of the thorax. The two-lipped to circular atrial aperture is directed posteriorly. Twelve parallel longitudinal muscles extend down each side of the thorax. Twelve long stigmata are in the anterior row on each side, reducing to nine in the posterior row. An extensive unperforated area is in the anterior part of the pharynx. A retractor muscle, sometimes fine and attenuated but sometimes short and thick, projects from the top to halfway down the long oesophageal neck. The large and voluminous gut forms a vertical loop and usually is filled with, and is obscured by, large faecal pellets. The large, spherical and undivided testis is surrounded by eight coils of the vas deferens.

Larvae are present in a number of the newly recorded specimens (QM G308679 G308723, NTM E 298 E315 collected in either June or August). They are identical with those previously described (Kott 2001 and 2004b) with a large trunk (1.2 mm long), a corona of 16 sometimes bifurcating club-shaped ampullae around the three antero-median adhesive organs and a circle of up to eight blastozooids around the trunk generated from the oesophageal region of the oozooid.

Remarks. Kott (2001) reported that neither gonads nor larvae were detected in the highly pigmented holotype specimen of *T. crystallinum* Kott, 2001 from the Northern Territory. This has been confirmed in a re-examination of the specimen. The larva in Fig. 124d (Kott 2001), which is said to be a larva of *T. crystallinum*, is actually from a specimen of *T. cristatum* Kott, 2001 (AM Y1541). Furthermore, although Kott's count of the stigmata in the branchial sac of *T. crystallinum* is correct, her count of the number of stigmata in South Australian specimens of *T. pseudodiplosoma* Kott, 2001 is incorrect. In a re-examination of the South Australian specimens on which Kott's (2001) study was based, the number of stigmata was found to be the same as in the holotype of *T. crystallinum*, of which it is the senior synonym.

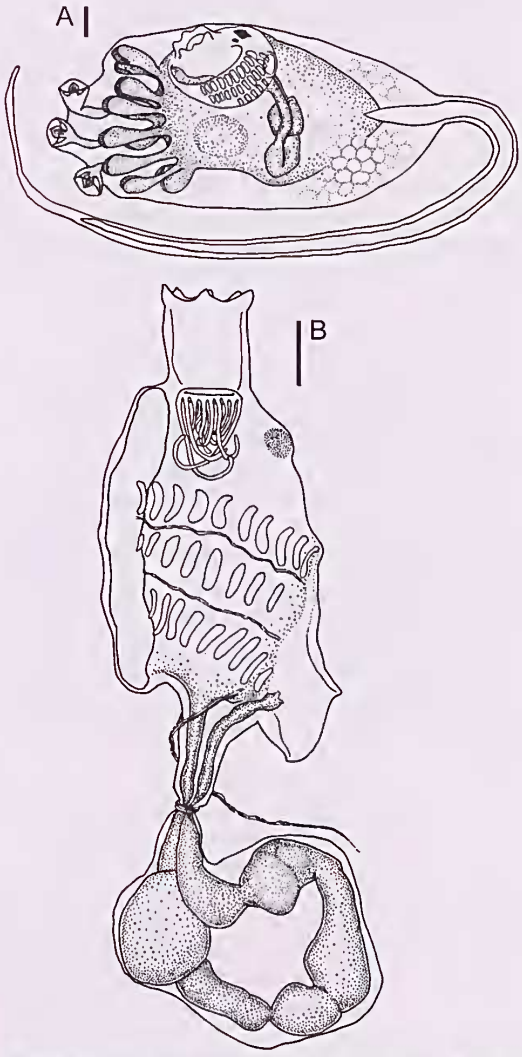

Fig. 18. *Trididemnum planum* (QM G308681): **A**, larva. *Trididemnum pseudodiplosoma* (NTM E315): **B**, zooid. Scale bars, 0.1 mm.

Intraspecific variation in the amount of black pigment significantly affects the external appearance of specimens of this species. The darkly pigmented oval cells are sometimes gathered into streaks forming a marble-like pattern in the surface (see colonies from South Shell Island: Kott 2004b, and the newly recorded specimens QM G308682, NTM E298 and NTM E315) but sometimes the colony has a completely black surface (see colony from Anglers Reef: Kott 2004b). The dark oval to spherical cells in the test of this species resemble those in similar locations marbling the surface of specimens of *T. marmoratum* and *T. planum* (see above).

Colonies always are soft, internally translucent three-dimensional masses, the test contains bladder cells throughout, zooids are large with the gut forming a vertical loop, and the unique larvae have numerous club-shaped lateral ampullae and ring of up to eight blastozooids. These unique larvae are known from unpigmented completely translucent colonies (from South Australia: types and QM GH3818, see Kott 2001; and from the Northern Territory: newly recorded colony QM G308679), as well as from specimens with a completely black surface (from the Northern Territory: QM G308649, Kott 2004b). Spicules are not generally found in this species, the only exceptions being burr-like and stellate spicules in a few specimens from both southern Australia (see *T. crystallinum* Kott, 2001 and *T. pseudodiplosoma:* Kott 2004b) and the Northern Territory (see NTM E298, above).

The present species can be identified always by its larvae, but in their absence, the lack of black squamous epithelium and endostylar pigment cap and the lack of large stellate spicules help to distinguish it from other sympatric, large, gelatinous colonies of this genus.

The new records confirm that, although *T. pseudodiplosoma* previously was thought to be confined to southern Australian waters, it is common in Darwin Harbour. It is one of the few species of the Didemnidae with a range that includes temperate and tropical waters, although the absence of records between the Northern Territory and southern Australia suggests that appropriate habitats in other locations have not yet been sampled. It has not been recorded from coral reef waters.

Lissoclinum badium F. and C. Monniot, 1996

(Fig. 24G)

Lissoclinum badium F. and C. Monniot, 1996: 170. – Kott, 2001: 297.

Distribution. *Previously recorded* (see Kott 2001): Western Australia (Bonaparte Archipelago), Queensland (Capricorn Group to Lizard Island), Coral Sea, Palau Islands. *New records*: Ashmore Reef, NTM E268; Northern Territory (Darwin, QM G308739; Bynoe Harbour, QM G308695).

Description. The colonies are the same soft to rubbery consistency as others have recorded. In life the colonies are beige with brown around the common cloacal aperture which protrude from the surface. In preservative, colonies are grey on the upper surface (where dark pigment cells are mixed with spicules). Spicules are sparse internally around the zooids and at zooid level the colony is dark brown. However spicules are crowded in the relatively thick basal layer of test where, in the absence of pigment, the colonies are an opaque creamish-white colour. The spicules are burr-like, to 0.03 mm diameter, with numerous rod-like rays. Zooids cross the vast common cloacal cavity in test connectives, either singly or in clumps, and these are anchored to the basal test by narrow basal test ligaments. Brown pigmented cells, sometimes mixed with spicules, are crowded around the zooids and obscure the body organs. These brown cells are 0.01 mm diameter and have conspicuous spherical particles crowded in them. Zooids are of the usual form, with two testis follicles.

Remarks. The living specimens have a characteristic appearance, although in preservative they can be readily confused with other species, especially *L. reginum,* which has similar spicules and two testis follicles. In this study the species have been distinguished by the large pigment cells in the test of present species. These large cells are not present in the haemocoel. The spicules are smaller than those of *L. reginum*, although its preserved colonies are similar to those of the present species.

Lissoclinum bistratum (Sluiter, 1905)

Didemnum bistratum Sluiter, 1905: 103.

Lissoclinum bistratum – Kott 2001: 298 and synonymy.

Not *Lissoclinum bistratum* – F. and C. Monniot 2001: 283.

Distribution. *Previously recorded* (see Kott 2001): Western Australia (Kimberley, Shark Bay), New South Wales (Lord Howe Island, Hastings Point), Queensland (Moreton Bay to Lizard Island), Northern Territory (Darwin), Coral Sea, Caroline Islands, Palau Islands, New Caledonia, Philippines, Tokhara Islands, Fiji, Indonesia, Singapore, Malagasy, Aden, Red Sea. *New records*: Western Australia (Shark Bay, WAM 1018.90; Christmas Island, WAM 602.89).

Remarks. Colonies of the newly recorded specimen lots from Christmas Island and Western Australia are the characteristic small cushions, with characteristic globular spicules throughout, a single undivided testis follicle and fine *Prochloron* cells in the common cloacal cavity.

Although they concede that the spicules are different and that there are differences in their chemistry, F. and C. Monniot (2001) have not been able to separate specimens of *L. bistratum* from *L. voeltzkowi* (Michaelsen, 1920), a junior synonym of *L. timorense* (Sluiter, 1909) and believe that these two species are conspecific. Although their differences are not discussed in the catalogue of valid species occurring in Australia (Kott 1998), these two species are well characterised, especially by their dramatically different spicules and

other aspects of their zooids, larvae and colonies (Kott 2001). It is not possible to assign the specimens newly recorded from the western Pacific by F. and C. Monniot (2001) to one or the other of these species.

Lissoclinum multifidum (Sluiter, 1909)

Leptoclinum multifidum Sluiter, 1909: 83.

Lissoclinum multifidum – Kott, 2001: 311 and synonymy; Kott 2002: 42; Kott 2004b: 2512.

Lissoclinum concavum Kott, 2001: 303 (new synonym).

Distribution. *Previously recorded* (see Kott 2001, 2002, 2004b): Northern Territory (Port Essington, Darwin), South Australia (Flinders Island, Wright Island, Franklin Island), Indonesia, Gulf of Thailand, Mauritius. *New records*: Northern Territory (Darwin-Mandorah Jetty, NTM E229); Tasmania (Forestier Peninsula, SAM E3242).

Description. The newly recorded colony from Tasmania (taken from kelp) is soft, encrusting and aspiculate and has white morulae in the test, although these are not crowded into conspicuous parallel bands. The preserved specimen looks like the photographed colony from Mandorah Jetty (which has sparse spicules to 0.015 mm diameter; see Kott 2002: fig. 27d) and the holotype of *Lissoclinum concavum* (see Kott 2001: pl.18h) which contains spicules (to 0.06 mm diameter). The newly recorded Northern Territory specimen has broad convoluted ridges with bands of white morulae (resembling bands of crowded spicules) as in the other photographed specimens from Darwin (Kott 2002: fig. 27e). Internally, all recorded specimens have clumps of six to eight zooids suspended in a large horizontal common cloacal cavity and anchored to the relatively thin basal layer of test by a thin connective. The test of all specimens contains morula cells to 0.04 mm diameter, which give it a cloudy appearance. Some of the larger of these cells are sparsely but evenly distributed in the test and, to the naked eye, look like minute spicules. However, they are not calcareous (are not dissolved in acid) and spicules were not detected in either of the newly recorded specimens. Branchial apertures appear to be slightly depressed into the surface, but this may be an artefact of the soft test. Common cloacal apertures are large and sessile, but are inconspicuous owing to the soft test. The zooids are large, with a large atrial aperture exposing most of the branchial sac directly to the common cloacal cavity. An atrial lip was not detected. A long, fine retractor muscle projects out from the top of the oesophageal neck. Stigmata are long and rectangular, about eight per row in the anterior row. The gut is folded up horizontally behind the thorax. A straight vas deferens originates from the centre of a rosette of eight (SAM E3242) or five or six (NTM E229) male follicles. Almost spherical larvae with a larval trunk to 0.75 mm long are being incubated behind the zooids. Three long club-shaped lateral ampullae are along each side of the three deep antero-median adhesive organs and the tail is wound about three-quarters of the way around the trunk. Blastozooids are present in the vicinity of the larval oesophageal neck.

Remarks. No morphological difference has been detected that would explain the dramatic difference that Kott (2002) reported in the appearance of the two photographed aspiculate specimens, both from Mandorah Jetty (Darwin). Although the presence of crowded spicules was regarded as the principal character distinguishing the temperate species, *L. concavum* Kott, 2001 from the tropical, aspiculate *L. multifidum* Sluiter, 1909, this distinction has not been sustained, some small spicules being present occasionally in tropical specimens (NTM E210; Kott 2001) and an otherwise identical newly recorded Tasmanian specimen is aspiculate (SAM E3242). Both tropical and temperate specimens contain the same morula bodies. However, although abdomina are always bent up under the thorax in both tropical and temperate specimens they either are embedded in the basal test or in the test connectives; and in both the clumps of zooids are often (but not always) surrounded by common cloacal cavity. In fact, the presence or absence of spicules and the extent of the common cloacal cavity are variable characters in what is one of the few species of the Didemnidae to have a continuous range from tropical to temperate waters. Furthermore, some intraspecific variation is to be expected in this species, one of the relatively few with a known geographic range from the West Indian Ocean to the West Pacific.

Lissoclinum reginum Kott, 2001

(Fig. 24H)

Lissoclinum reginum Kott, 2001: 319 and synonymy. – Kott 2004a: 770; Kott 2004b: 2514.

Distribution. *Previously recorded* (see Kott 2001, 2004b): Western Australia (Port Hedland), Queensland (Capricorn Group, Swain Reefs, Lizard Island), Northern Territory (Darwin), Indian Ocean (Cocos Keeling Islands). *New records*: Ashmore Reef, NTM E240 E278; Northern Territory (Bynoe Harbour, QM G308696, G308737).

Description. Colonies have patches of yellow pigment on the surface, which is white with crowded spicules. Dark brown cells 0.005 mm diameter are in the test and surround the zooids and are gathered into spherical or oval masses in the basal test and some are in the haemocoel. These cells appear not to be granular. Minute pigment cells are mixed with spicules in the superficial layer of test. Spicules are present throughout the test. They are burr-like, to 0.045 mm diameter, with numerous rod-like rays. Thoraces, and sometimes the whole zooid, cross an extensive common cloacal cavity in a sheath of test, although the abdomina sometimes are embedded in the basal test. Zooids are of the usual *Lissoclinum* type with a large rectangular thorax, a wide, open, sessile atrial opening and a short retractor muscle. Two testis follicles are joined to the vas deferens by short vasa efferentia.

Remarks. These thin sheet-like colonies with dark brown cells around the zooids and in the haemocoel are readily confused with other *Lissoclinum* spp. which have similar, small, burr-like spicules and two male follicles. In the present study the form and size of the brown cells can be used to distinguish the species from *L. badium* (see above) which has larger brown cells with distinct spherical bodies in them and smaller spicules and softer colonies. The present species has a short retractor muscle, which is not present in *L. badium, L. maculatum* or *L. ostrearium.*

Living colonies of the present species are reported to have been cream with variable patches of blue to purple or grey (Kott 2001) or to have been beige or white (Kott 2004b). Newly recorded specimens are purple (NTM E240), white (NTM E278), cream with orange patches (QM G308737) and red (QM G308696).

***Lissoclinum taratara* C. and F. Monniot, 1987**

(Fig. 25A)

Lissoclinum taratara C. and F. Monniot, 1987: 52. – Kott 2001: 325 and synonymy.

Not *Lissoclinum taratara* F. and C. Monniot 2001: 284 (< *L. pacificense*).

Lissoclinum guinense F. and C. Monniot, 2001: 283 (new synonym).

Distribution. *Previously recorded* (see Kott 2001, F. and C. Monniot 2001): Queensland (Lizard Island), New Guinea, French Polynesia. *New record*: Ashmore Reef, NTM 290. The four specimens of this species that have been recorded are from widely separated locations.

Description. The newly recorded colony is a fleshy translucent cushion with one layer of spicules beneath a superificial layer of bladder cells, and another layer in the base of the colony. Spicules are sparse elsewhere. They are characteristic of the species, having four long, tapered arms made up of long parallel, graded rays with a tuft of shorter graded rays in the centre of the spicule (at the base of the long arms). The distance between the tips of two long arms is up to 0.09 mm.

Remarks. Although the spicule distribution of the newly recorded specimen differs from those previously recorded (which have spicules crowded through the colony beneath the thick surface bladder cell layer), the spicules are characteristic. They separate the species from others with long, four-armed spicules, namely *L. pacificense* (Kott, 1981), which has a central tuft of spicule rays as in the present species but is distinguished by its smaller spicules and the capsules they form around the zooids; *L. tuheiavae* C. and F. Monniot, 1987, which has spicules to 0.18 mm between the tips of opposite arms, i.e. almost twice the size of the present species; and *L. sente* Kott, 2001 and *L. tasmanense* Kott, 2001, which both lack a central tuft of rays.

Lissoclinum guinense F. and C. Monniot, 2001 from New Guinea has no specific characters in common with either *L. verrilli* (Van Name, 1902) or *L. triangulum* (Sluiter, 1909), the species that were compared with it to establish its uniqueness. Kott (2004b) thought that *L. guinense* may be a synonym of *L. calycis* Monniot, 1992, but it lacks the much larger central tuft of needle-like rays of the latter species and, although the original description of the type material is of generic characters or others that have no particular significance at species level, its spicules (F. and C. Monniot 2001: figure 6A) appear to be identical in size and form to those of the present species and the larva appears to be the same as the larva described for *L. triangulum* Millar, 1975, a junior synonym of the present species.

***Lissoclinum timorense* (Sluiter, 1909)**

Didemnum timorensis Sluiter, 1909: 51.

Lissoclinum timorensis – Kott 2001: 328 and synonymy.

Distribution. *Previously recorded* (see Kott 2001): Queensland (Capricorn Group to Lizard Island, Great Barrier Reef), Solomon Islands, Indonesia, New Caledonia, Caroline Islands, Philippines, Palau Islands, Guam, Fiji, Malagasy. *New record*: Ashmore Reef, WAM 625.89.

The newly recorded colony is from a sandy reef flat, a habitat often favoured by this species, as Kott (2001) observed in Fiji.

***Diplosoma translucidum* (Hartmeyer, 1909)**

(Figs 19; 25B)

Leptoclinum translucidum Hartmeyer, 1909: 1490 (*nom. nov.* for *Leptoclinum perspicuum* Sluiter, 1909: 79).

Diplosoma translucidum – Kott 2001:343 and synonymy; Kott 2002: 43; Kott 2004b: 2524.

Distribution. *Previously recorded* (see Kott 2001, 2002, 2004b): Western Australia (Dampier Archipelago, Cape Ruthiers, Cape Jaubert), Queensland (Hervey Bay, Capricorn Group, Lizard Island), Northern Territory (Darwin); Indonesia, New Caledonia. *New records*: Western Australia, WAM 1070.89; Northern Territory (Darwin, NTM E292; Bynoe Harbour, QM G308744).

Description. One of the newly recorded colonies (WAM 1070.89), a small scrap with characteristically fibrous test, black squamous epithelium on the abdomen and two testis follicles, is not included in the following description, which applies principally to the other newly recorded robust colony from the Northern Territory which forms translucent networks encrusting weed stalks. The test contains the usual corpuscles, about 0.01 mm diameter, previously reported from species of this genus. Although these are opaque and superficially appear to be spicules, they are not calcareous and do not dissolve in acid. They are especially crowded around the branchial apertures, they form a single layer that closely encapsulates each zooid and obscures its structure and they also are scattered sparsely in the remainder of the test. Zooids are tightly enclosed in test connectives

between surface and basal test and are difficult to remove from the colony. The test is tough and the basal test (which in the newly recorded colony forms a central core around the weed stalk) is especially tough and fibrous. Zooids have eight stigmata in the anterior row and two testis follicles. Abdomina are folded up behind the large thoraces. Two testis follicles are behind the ventrally flexed gut loop. Larvae, present in the newly recorded colonies from the Northern Territory (collected in June), have a small trunk, a dorsal and a ventral ectodermal ampulla and two pairs of lateral ampullae (two each side of the three antero-median adhesive organs. Transversely elongate patches of crowded corpuscles, similar to those reported from the colonial test, are in the larval test encircling the posterior end of the trunk. As the larva matures, the corpuscles forming these patches disperse into the larval test, including the tail fin. Oozooid and blastozooids are close to the anterior end of the larval trunk, just behind the lateral ectodermal ampullae. The cerebral vesicle is separated from the oozooid, and the oozooid and the blastozooid (of equal size) separate from one another before settlement. Mature larvae are held in the floor of the common cloacal cavity in a brood pouch constricted off from the basal test by a narrow neck.

Remarks. The tough, fibrous, basal test (see Kott 2001) is particularly conspicuous in the newly recorded specimen and apparently is a characteristic of this species. Black squamous epithelium, sometimes reported on abdomina in this species, is present in one specimen only (WAM 1970.89).

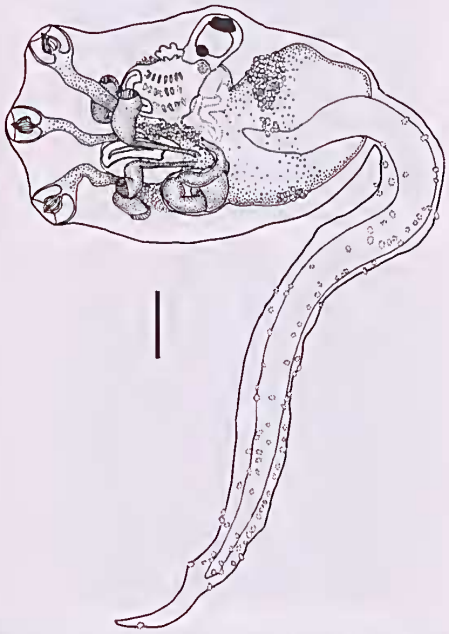

Fig. 19. *Diplosoma translucidum* (NTM E292): larva. Scale bar, 0.1 mm.

The larvae appear to have moved into the brood pouches from the basal test rather than remaining attached to the abdomen as in *D. versicolor* (see Kott 2001).

Diplosoma versicolor Monniot, 1994

(Figs 25C, D)

Diplosoma versicolor Monniot, 1994: 9. – F. and C. Monniot 2001: 280.

Diplosoma ferrugeum Kott, 2001: 337 and synonymy; Kott 2004b: 2524 (new synonym).

Distribution. *Previous records* (see Kott 2001, 2004b; F. and C. Monniot 2001): Western Australia (Montebello Islands, Houtman's Abrolhos), New South Wales (Lord Howe Island), Queensland (Capricorn Group, Swain Reefs, Townsville, Lizard Island), Northern Territory (rocky reef, Darwin), Philippines, New Caledonia, Micronesia. *New records*: Ashmore Reef, NTM E262-3; Northern Territory (Bynoe Harbour, QM G308697).

Description. The newly recorded specimens have the same soft test with dark brown spherical cells and morulae distributed throughout. The morulae are especially crowded in the surface forming opaque patches and streaks that create a marble-like pattern with the clouds of minute yellowish-brown particles suspended in the surface test. The opaque morulae characteristic of this species (see Kott 2001), together with the yellowish brown suspension, surround and obscure the zooids, which are enclosed in ligaments of test that suspend them between the surface and the basal test. Thoraces are attached separately to the surface test, but the abdomina are often in clumps, some attached to the basal test by a ligament but others partially embedded in the basal test. Abdomina are also encased in black squamous epithelium. Thoraces are large, with 12 stigmata in the anterior row on one side and there are two testis follicles. The larger colony (NTM E263) has mature testes.

Remarks. Although living colonies of this species are readily identified by their marbled colour pattern, there is much change with growth in this species, and the preserved colonies are often difficult to identify only by the form of the common cloacal systems. However, the test is always soft, the brown pigment is always present, mixed with the morulae that encase and obscure the zooids. Opaque bodies that are mistaken for spicules (but do not dissolve in acid) are present in both *Diplosoma* and *Lissoclinum* spp., as in *D. fecundum* Kott, 2004b, *D. translucidum* (Hartmeyer, 1909), *D. velatum* Kott, 2001, *L. multifidum* (Sluiter, 1909), *L. lanema* Kott, 2004b, however these do not appear to be the same as the morula bodies found in the present species (see Kott 2001: fig. 178h).

Although Kott (2001) compared *Diplosoma ferrugeum* Kott, 2001 with Monniot's (1994) description of the type material of the present species from New Caledonia, she did not think they were conspecific,

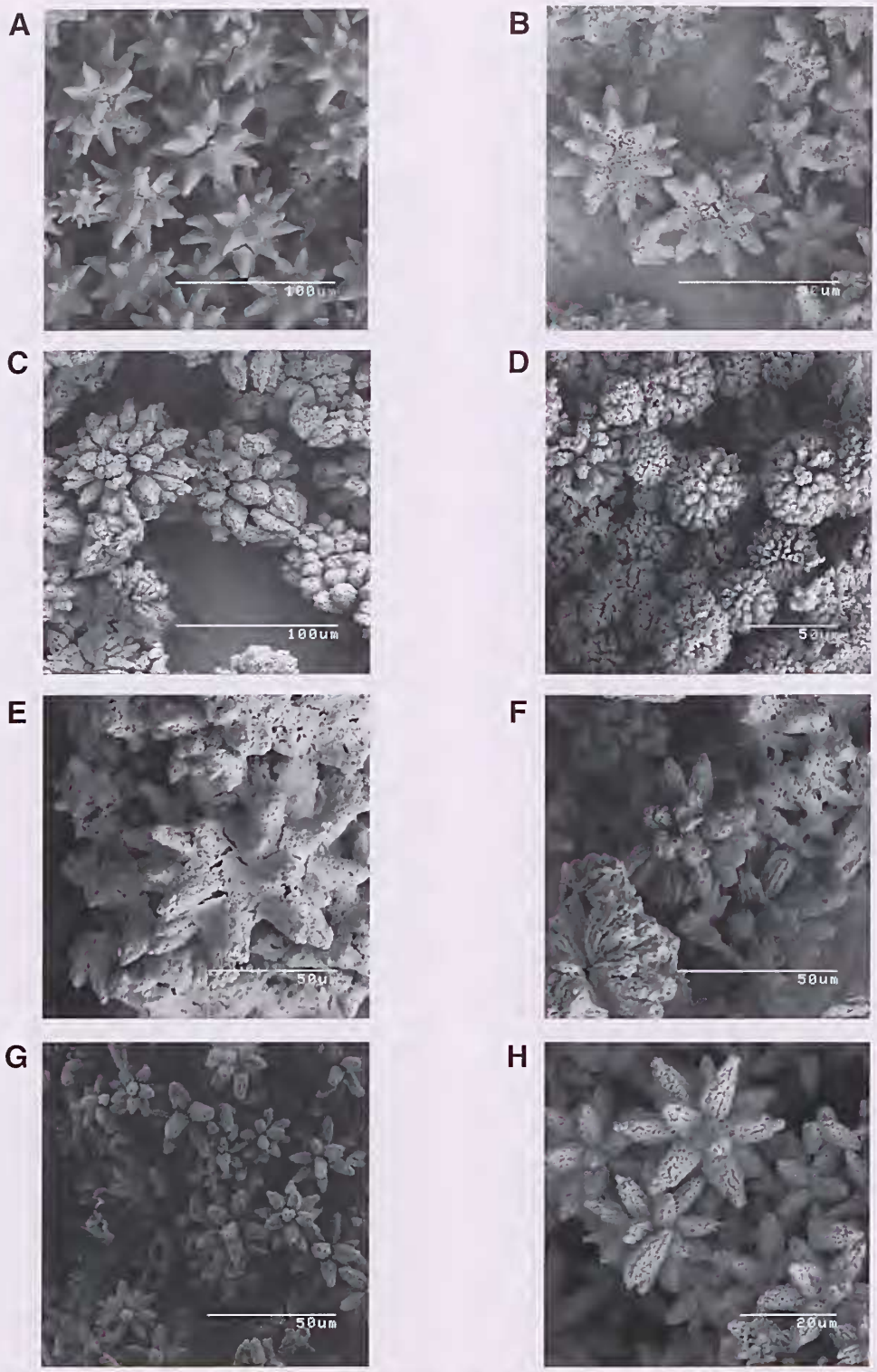

Fig. 20. Scanning electron micrographs of calcareous spicules from the test of: **A**, *Leptoclinides aciculus* (WAM 129.90); **B**, *Polysyncraton alingnum* (NTM E311 holotype); **C**, *Polysyncraton arvum* (NTM E289 holotype); **D**, *Polysyncraton niveum* (NTM E233 holotype); **E**, **F**, *Didemnum aratore* (NTM E256 holotype); **G**, **H**, *Didemnum domesticum* (NTM E237 holotype).

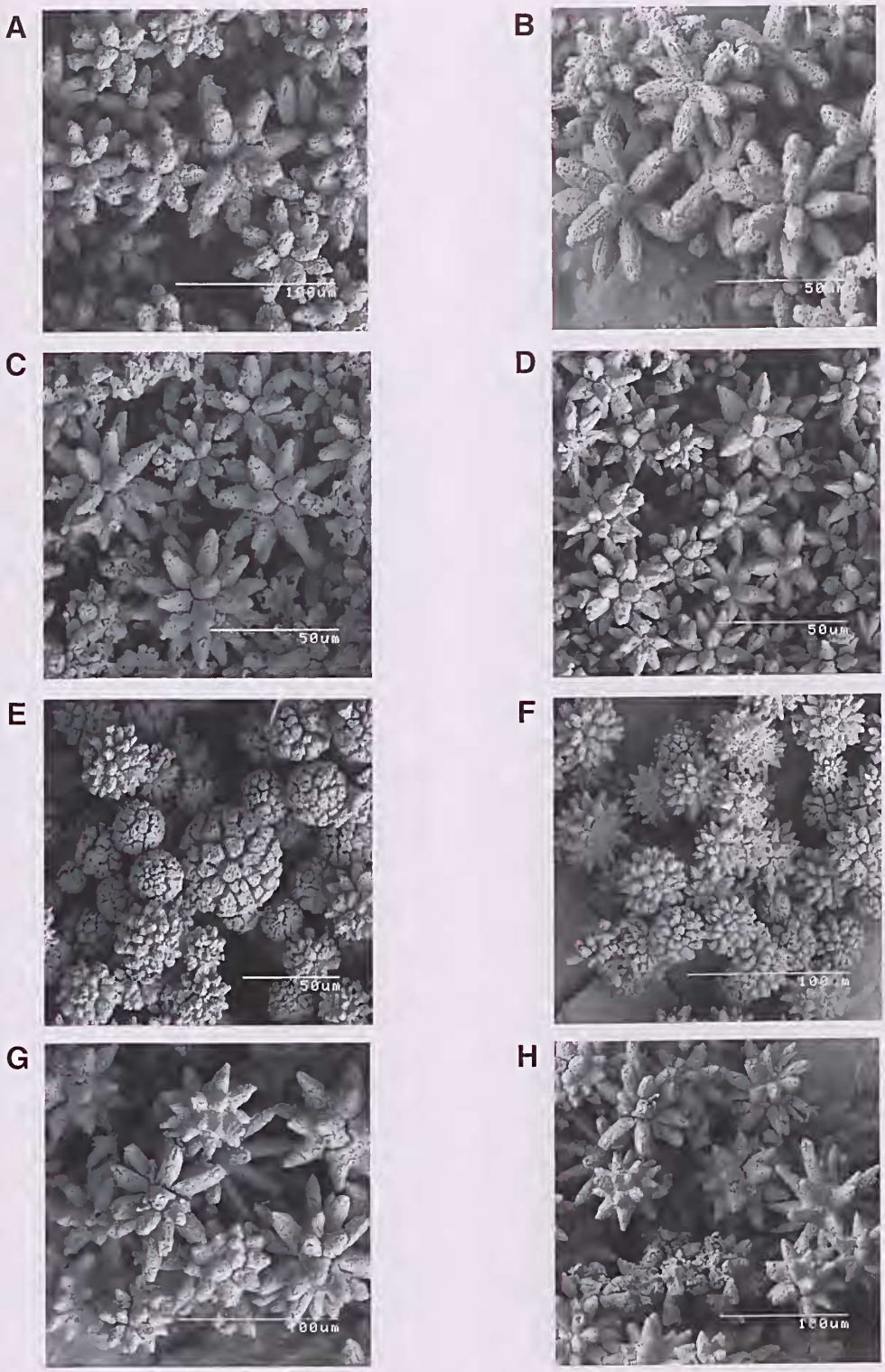

Fig. 21. Scanning electron micrographs of calcareous spicules from the test of: **A**, *Didemnum lillipution* (NTM E250 holotype); **B**, *Didemnum rota* (NTM E241 holotype); **C**, *Didemnum tumulatum* (NTM E279 holotype); **D**, *Didemnum usitatum* (NTM E259 holotype); **E**, **F**, *Didemnum vesperi* (NTM E239 syntype); **G**, **H**, *Tridemnum farrago* (NTM E253 holotype).

largely because the latter colonies were globular and did not form thin sheets, and Monniot (1994) did not report the characteristic morulae. Nevertheless, the New Caledonian colonies are said to have brown-purple pigments marbled with pale yellow, a description that is not inconsistent with the grey or cream streaks and the brown, tan, orange and yellow shades in the identical marbled pattern of the Australian specimens. It is most probable that the pattern is formed by the same, crowded opaque morulae in both. Furthermore, although the formation of a brood pouch from the base of a test ligament that Kott (2001) described has not been found in specimens assigned to *D. versicolor*, and the larvae in specimens from the Philippines and Micronesia (F. and C. Monniot 2001) are not suffficiently well developed for the larval organs to be determined, they are the same size and shape as Kott's species and they are undoubtedly conspecific.

Family Styelidae
Subfamily Styelinae

The genus *Symplegma* contains what appear to be closely related species, all with four internal longitudinal vessels on each side of the body, between eight and 18 rows of stigmata and between 20 and 35 stigmata in each half row, a short gut loop but a relatively long rectum, from about 10 to 19 stomach folds and a short straight to curved gastric caecum and gonads consisting invariably of an anterior and a posterior fan-shaped and lobed to club-shaped testis follicle on each side of the body, converging to the vas deferens between the two follicles where there is a small sac-shaped ovary. Viviparous larvae have, as far as is known, two or three pointed papillae and one or two sense organs.

Key to Australian tropical and sub-tropical species of *Symplegma*

1a. Testis follicles entire (not lobed) 2
1b. Testis follicles lobed... 5
2a. Zooids arranged in circles ..... *S. teruakii* sp. nov. (Great Barrier Reef, Timor Sea)
2b. Zooids not arranged in circles 3
3a. Stigmata more than 20 in more than ten rows ..... *S. viride* Herdman,1886 (Bermuda, Caribbean)
3b. Stigmata less than 20 in less than ten rows 4
4a. Stigmata in 7–8 rows ..... *S. reptans* Oka, 1927 (Japan, Amoy, South China Sea, southern California?)
4b. Stigmata in 11–12 rows ..... *S. zebra* Monniot, 2002 (Madagascar, Maldives)
5a. Stigmata 30 or more rows 6
5b. Stigmata less than 30 rows 7
6a. Apertures joined by pigment circle ..... *S. rubra* Monniot, 1972 (Bermuda, Caribbean, Tanzania, Timor Sea)
6b. Apertures not joined by pigment circle ..... *S. alterna* Monniot, 1988 (New Caledonia)
7a. Zooids intensely pigmented, opaque ..... *S. bahraini* C. and F. Monniot, 1997 (Arabian Gulf, Mozambique, Timor Sea)
7b. Zooids not intensely pigmented, nor opaque ..... *S. brakenhielmi* (Michaelsen, 1904) (Gulf of Mexico, Caribbean, Brazil, West Indian Ocean, West Pacific and Timor Sea)

Symplegma bahraini C. and F. Monniot, 1997

(Fig. 25E)

Symplegma bahraini C. and F. Monniot, 1997: 1638. – Monniot 2002: 67.

Distribution. *Previously recorded* (see Monniot 2002): Arabian Gulf, Mozambique. *New record*: Ashmore Reef, NTM E284.

Description. In preservative, the newly recorded colony is a robust slab about 5 cm in maximum dimension and 1 cm thick. Black zooids occupy the upper half of the colony where the test between the zooids is translucent like that in the lower half of the colony where it contains test vessels. The zooids are completely embedded almost vertically in the test, their anterior ends at the surface. The branchial and atrial apertures are on small, short siphons relatively close together. Zooids near the margins of the colony are slightly oblique, lying on their postero-ventral surface, presenting more of their dorsal margin to the surface of the colony and their apertures are further apart. Branched but not especially long terminal ampullae are around the margins of the colony. In life, the colony is a bright opaque yellow colour.

Fourteen rows of stigmata are in the branchial sac with about 31 stigmata in each of the rows. The gut forms the usual tight loop with a curved gastric caecum attached by two ligaments (one from the tip and one from the outer curve of the caecum) to the closest part of the gut wall. The rectum is long and curves over onto the dorsum of the zooid to open at the base of the atrial opening. The stomach is more or less pyriform and has 15 longitudinal folds. The gonads consist of an anterior and a posterior longitudinally oriented fan-shaped and deeply lobed testis follicles on each side of the body, each converging to the vas deferens that is between them, curving around the ovary, which in the newly recorded colony is a single large oocyte and a smaller egg.

Remarks. The number of stomach folds, the large number of stigmata in each row, the number of rows of stigmata, together with the deeply branched testis follicles and the bright opaque colour of the living colonies appear to be characteristic of the species.

Symplegma alterna has similar opaque red or yellow zooids, 14 or 15 rows of stigmata, more than 30 stigmata per row and especially deeply divided testis follicles like *S. bahraini*. Despite the 19 stomach folds that are said to

distinguish *S. alterna*, it is possible that the two species are synonyms. Monniot (1988) thought that *S. alterna* was distinguished from others by its protandrous condition, the testis and ovary not being present at the same time. However it is possible that there are various degrees of protandry, with varying intervals between the maturation of male and female gonads, respectively, and although male and female gonads often are reported to be present together, they usually are not mature at the same time.

***Symplegma brakenhielmi* (Michaelsen, 1904)**

(Fig. 25F)

Diandrocarpa brakenhielmi Michaelsen, 1904: 50. – Herdman 1906: 33 var. *ceylonica*.

Symplegma brakenhielmi – Monniot 1983: 429; Rodriguez and Rocha 1993: 733; C. and F. Monniot 1997: 1636.

Symplegma viride – Michaelsen 1918: 39; Michaelsen 1919: 101; Michaelsen in Hartmeyer and Michaelsen 1928: 358; Van Name 1921: 404–407 var. *brakenhielmi*; Van Name 1930: 482; Millar 1966: 368; Plante and Vasseur 1966: 149; Tokioka 1967: 162 (part, specimen from Thailand).

Symplegma oceania Tokioka, 1961: 114. — Kott 1981: 199; Kott 1985: 257; Kott and Goodbody 1982: 531; C. and F. Monniot 1987: 106; Monniot 1988: 177.

Symplegma stuhlmanni — Kott 1998: 202.

Gynandrocarpa quadricornulis Sluiter, 1904: 127.

Gynandrocarpa similis Sluiter, 1904: 97.

Distribution. *Previously recorded*: Indian Ocean and the western Pacific (Sluiter 1904; Herdman 1906; Michaelsen 1918, 1919, 1928; Monniot 1988; C. and F. Monniot 1987, 1997; F. and C. Monniot 1997; Kott 1981, 1985; Kott and Goodbody 1982). Gulf of Mexico, Caribbean (Michaelsen 1904; Van Name 1921, 1930; Monniot 1983; Rodriguez and Rocha 1993). *New records*: Ashmore Reef, NTM E281, E283.

Although the type location of this species is in the Atlantic, the records are principally from the Pacific and Indian Oceans.

Description. The newly recorded colonies are thin and grey, the zooids dorso-ventrally depressed and lying on their ventral surface. Ten or 11 rows of stigmata are in the branchial sac, three stigmata are between the internal longitudinal vessels and five or six are between the adjacent vessel and the endostyle and dorsal lamina respectively. Ten folds are in the stomach wall. A small immature ovary is present and the usual lobed male follicles are maturing in these specimens collected on October.

Remarks. *Symplegma brakenhielmi* (Michaelsen, 1904) was first described from the Gulf of Mexico. Specimens from the Indian and western Pacific Oceans (Herdman 1906; F. and C. Monniot 1997) have been assigned to the species as well as other specimens from the Atlantic in which the characters of the zooids are not reported (Monniot 1983; Rodriguez and Rocha 1993). The species and its synonyms have 10–16 stomach folds, up to 27 stigmata in each of 8–14 rows of stigmata (3–6 per mesh) and a long vas deferens free in the peribranchial cavity.

Symplegma oceania Tokioka, 1961 from the western Pacific (Noumea), with 13 stomach folds and 13 rows of about 27 stigmata are thought to be conspecific with *S. brakenhielmi* (see Kott 1985, 1998; C. and F. Monniot 1997), including specimens assigned to *S. oceania* from Fiji, the South China Sea (Kott 1981; Kott and Goodbody 1982), New Caledonia (Monniot 1988) and Australia (Kott 1985).

Van Name (1930, 1945) thought that specimens of *S. viride* with entire follicles and *S. brakenhielmi* with lobed follicles to be conspecific. Although he did not detect the long vas deferens characteristic of the latter species in his material and it is possible that his specimens are one of the other species, that species does not appear to be conspecific with the primarily Atlantic Ocean *S. viride*.

Symplegma bahraini C. and F. Monniot, 1997 has characters that fall within the range of *S. brakenhielmi* and its synonyms, having 12–14 stomach folds, 10–12 rows of stigmata and about 27 stigmata per row. C. and F. Monniot (1997) distinguish the species from *S. brakenhielmi* by its two sense organs and three papillae, rather than the one sense organ and three papillae in *S. brakenhielmi* (see Kott 1985). However, at this stage, few larvae have been described and more data are needed to establish this as a reliable character. *Symplegma viride*: Vasseur, 1967, from Mauritius, has 'numerous' stomach folds, 13 rows of stigmata and a deep red, yellow, orange or grey colour and is thought to be conspecific with *S. bahraini*; and *S. viride* Plante and Vasseur, 1966 from Malaysia, with 14 stomach folds, 10–13 rows of stigmata and transparent zooids, is conspecific with *S. brakenhielmi*. However, *S. bahraini* may be more robust than *S. brakenhielmi* and its bright yellow or red opaque zooids appear to constitute a distinguishing character that it shares with *S. alterna* (see above).

Michaelsen (1934) had some difficulty in resolving the relationships between *Distoma elegans* Quoy and Gaimard, 1834 and the present species. Although the type specimen of the former species is lost, Hartmeyer (1912) eventually achieved a satisfactory synthesis when he recognised that the described colour pattern, colony form, terminal ampullae of test vessels and arrangement of zooids in the colony of the Quoy and Gaimard species all resembled *Synstyela monocarpa* Sluiter, 1898, a sympatric species from southern Africa; and (although Michaelsen later thought *S. monocarpa* to be a species of *Symplegma*), from an examination of two specimens from southern Africa and from Sluiter's description, found them to be specimens of a species of *Chorizocarpa*. This species, *Chorizocarpa elegans* (Quoy and Gaimard, 1834) should

not be confused with the present species, and Michaelsen's (1934) proposal that they are conspecific is incorrect.

Tokioka (1967) considered the present species a synonym of *S. viride*. *Symplegma viride* Tokioka, 1967 includes new material from Thailand, Amoy and the Palau Islands, which are all probably different species. The specimens from Thailand have 10–12 rows of stigmata and 11–13 stomach folds and probably belong to the present species although the specimen from Palau with 19 stomach folds does not. The specimen from Amoy with its undivided testis follicles may belong to *S. reptans* Oka, 1927.

Kott's (1998) separation of all West Indian Ocean and western Pacific (including Australian) specimens from *S. brakenhielmi* as *S. stuhlmanni* Michaelsen, 1904 on geographic grounds alone is inappropriate.

Furthermore, the extent to which the pallial body wall is distended by developing gonads as a means for distinguishing species from one another is not reliable and cannot be validated (see C. and F. Monniot 1997: fig. 7A, in which the body wall is clearly distended, a condition which these authors then thought would distinguish *S. brakenhielmi* from *S. oceania*). *Symplegma oceania*, C and F. Monniot, 1987 has not been placed in subsequent synonyms by these authors, although the length of the oviduct and other characters suggests that they are accurately identified.

The status of *Gynandrocarpa quadricornulis* and *G. similis* were confirmed by examination of the types (see Kott 1985).

Symplegma rubra Monniot, 1972

(Figs 25G, H)

Symplegma rubra Monniot, 1972: 622. – F. and C. Monniot 1997: 26 and synonymy.

Distribution. *Previously recorded* (see F. and C. Monniot 1997): Atlantic Ocean (Bermuda, Brazil, Jamaica, Guadaloupe), west Indian Ocean (Mozambique, Tanzania). *New records*: Ashmore Reef, NTM E245, E288.

Description. The newly recorded colonies are reddish brown thin encrusting colonies with the zooids lying conspicuously parallel on their ventral surface in the thin test. In life, one of the specimens is salmon pink (NTM E245) and the other is raspberry red. A brick-red line radiates out from each side of each aperture and usually the lines on one side join one another on the sides of the zooid and complete a full circle around the anterior end of the zooid, including the aperture in the circle. The smaller zooids are inside the outer margins of the colony where especially long terminal ampullae of the test vessels lie parallel to one another. Fourteen rows of stigmata are in the branchial sac and stigmata are arranged between the internal longitudinal vessels according to the formula E7-6-6-6-6-DL. Eleven conspicuous stomach folds are emphasised by a line of pigment in the body wall that lies between the folds. The gut has the usual loop and a moderate-sized curved caecum attached to the gut by two ligaments, one of which is branched. The two lobed testis follicles are lined up on each side of the body but the ovary was not detected in these specimens.

Remarks. The present species has 11–13 stomach folds, 10–14 rows of stigmata and about 30 stigmata per row. Apart from the number of stigmata in each row, which is relatively high, these characters fall within the range for *S. brakenhielmi*. The only significant difference appears to be the red lines that radiate from each side of both apertures and in most zooids join into a circle that crosses both apertures around the anterior part of the zooid (see also F. and C. Monniot 1997: pl. 3c). It should be empasised that this line joins the apertures; it does not encircle them as Monniot (2002) suggested. It does not appear to be the same as the red line that encircles the apertures in some specimens of *S. brakenhielmi* (see *S. oceania* Tokioka, 1961 and *S. brakenhielmi ceylonica* Herdman, 1906). Some of the colonies assigned to *S. brakenhielmi* could belong to the present species as both species look alike in preservative.

Symplegma teruakii sp. nov.

Symplegma reptans – Kott, 1985: 258; Kott 1998: 202.

Distribution. *Previously recorded*: Queensland (Heron Island, Wistari Reef: Kott 1985). *Type locality*: Queensland (Wistari Reef, low tide rubble fauna, coll. P. Kott, 27 February 1984, holotype QM GH2603; Heron Island reef, low tide rubble fauna, coll. P. Kott, June 1982, paratype QM GH2636). There are no new records of this species.

Description. See *S. reptans* (Kott, 1985).

Remarks. Dr. Teruaki Nishikawa first suggested that the specimens from the Great Barrier Reef that Kott (1985) had assigned to the Japanese species *S. reptans* (Oka, 1927) appeared to be different from it. The Australian colonies were all pink in life with the zooids arranged in circles, the atrial openings in the centre of the circle, an arrangement emphasised by a white triangular mark in the test over the prebranchial area of each zooid. In *S. reptans* there is no white patch and the zooids are not arranged in circles. Further, the Australian species has 11 rows of stigmata with up to 28 in each row and a barrel-shaped stomach with eight distinct folds, while the Japanese species has only eight or nine rows of stigmata with 18 or 19 stigmata in each row and nine or 10 stomach folds. *Symplegma zebra* Monniot, 2002 is similar to the present species and *S. reptans* in its eight or nine stomach folds and entire testis follicles. It has 11 rows of stigmata like the present species but only about 18 stigmata per row and sometimes brownish or brownish yellow zooids like *S. reptans*. The zooid arrangement in *S. zebra* is not clear from the description of the type, some of the zooids appearing to be in circles.

The circular arrangement of zooids and the pink and white daisy-like pattern of the living colonies distinguish this species from all other known species in this genus.

The species is named for Dr. Teruaki Nishikawa, an ascidian taxonomist of great distinction from the University of Nagoya.

Family Pyuridae

Pyura gangelion (Savigny, 1816).

Cynthia gangelion Savigny, 1816: 90.

Pyura gangelion – Monniot 2002: 100 and synonymy.

Pyura tongaea C. and F. Monniot, 1976: 381. – Monniot 2002: 104 and synonymy (new synonym).

Distribution. *Previously recorded* (see Monniot 2002): Red Sea, western Indian Ocean, circum-Australia, Papua New Guinea, New Caledonia. *New record*: Darwin (Cullen Bay, NTM E331; Wickham Point channel, NTM E335).

Remarks. The species is in large aggregations with *Microcosmus exasperatus* and *M. squamiger* on harbour installations.

The species is distinguished primarily by its siphonal armature, which extends in double rows out onto the outer surface of the siphons and down the sides of the zooids. In order to assess the length and form of these siphonal spines they should be examined by light microscopy, the part of the spine embedded in the test being obscure in scanning electron micrographs. The larger spines are 0.25–0.275 mm long overall and the smaller ones scattered amongst them are 0.1 mm. The latter are obscured by the larger spines if the outer cuticle of test (in which they are fixed and which lines the siphons) is not removed from the underlying body wall and spread out on a glass slide. Monniot (2002) describes the spines as being 0.1 mm long, presumably being the part of the larger spine projecting from the test that he was able to measure on scanning electron micrographs. The species appears to be conspecific with the sympatric *Pyura tongaea* C. and F. Monniot, 1976 from Mozambique, which has a similar mixture of large and small spicules.

Microcosmus exasperatus Heller, 1878

Microcosmus exasperatus Heller, 1878: 17. – Kott 1985: 348 and synonymy; Monniot, 2002: 105 and additional synonymy.

Distribution. *Previously recorded* (see Kott 1985; Monniot 2002): West Indian Ocean, Gulf of Aden, western and eastern coasts of Australia, Northern Territory, Arafura Sea, Indonesia, New Caledonia, Fiji, Formosa, West Indies. *New record*: Northern Territory (Cullen Bay, NTM E332).

Remarks. Like *M. squamiger* Hartmeyer and Michaelsen, 1928, *M. exasperatus* has eight or nine branchial folds; like *M. madagascariensis* it has a deeply curved gut loop open at the pole; and like *M. madagascariensis, M. squamiger* and *M. pupa* the gonads cross the gut into the pole of the gut loop. The gonads generally are lobed in *M. madagascariensis*, divided into series of blocks in *M. exasperatus* and *M. squamiger* and often undivided and diffuse in *M. pupa.* However, the form of the gonads and the position of the endocarps on the body wall often are obscured when the gonads are well developed. Despite these similarities and variation in the appearance of the gonads, these species are readily distinguished by their siphonal armature. The present species is distinguished from others in this genus by its characteristic spicules, to 0.05 mm long from the pointed tip projecting into the lumen of the siphon to the posterior end of the open base which is drawn out and terminates in a bilobed knob (see Kott 1985, fig. 167e,d). The siphonal spines of *M. madagascariensis* Michaelsen, 1918 are similar but longer (0.075–0.1 mm) while those of *M. pupa* (Savigny, 1816) are even longer (0.15 mm) and have a closed rather than an open base like the first two species. However, to detect these differences, it is essential that the whole spine is examined and not just the part that projects from the test and for that reason it should be examined by light rather than scanning electron microgrophy.

Monniot (2002) suggested that *M. pupa* and *M. madagascariensis* resemble one another and certainly the scanning electron micrographs of the projecting tips of their siphonal spines are alike and indistinguishable from the spines of other species discussed here. Nevertheless, the latter species is much more like *M. exasperatus*, with deeply curved gut loops and siphonal spines with an open base. It is possible that *M. madagascariensis*: Monniot, 2002 is misidentified as it lacks the characteristic deeply curved gut loop and its gonads look more like those of *M. pupa. Microcosmus pupa* Monniot, 2002 (which Monniot thought resembled *M. exasperatus,* although he was unable to detect the curvature of the narrow gut loop) appears to have the gonads of *M. madagascariensis.*

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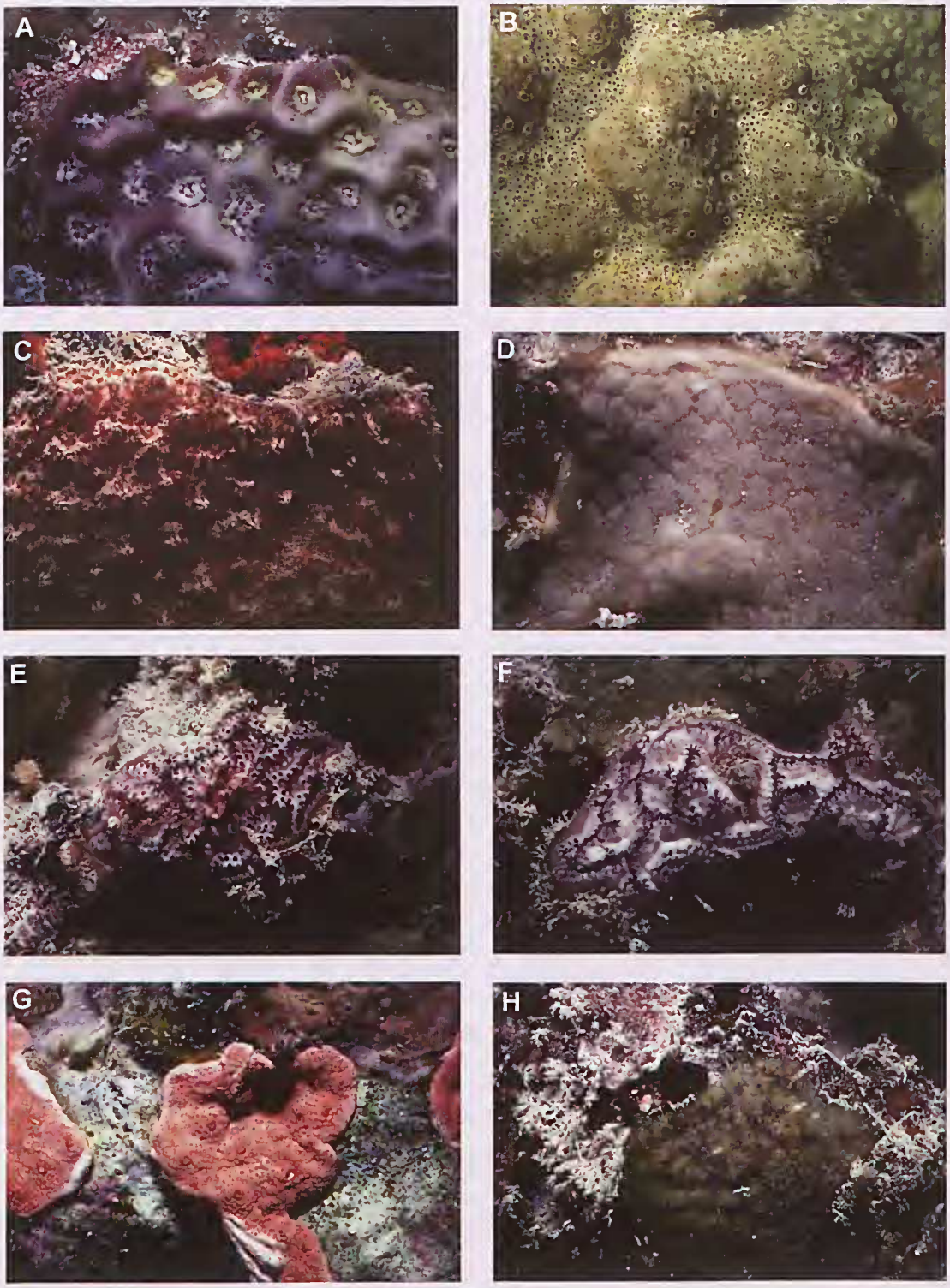

Fig. 22. **A**, *Eudistoma eboreum* (NTM E291); **B**, *Eudistoma sluiteri* (QM G308753); **C**, *Distaplia racemosa* (NTM E297); **D**, *Polysyncraton arvum* (NTM E 289 holotype); **E**, **F**, *Polysyncraton niveum* (NTM E233 holotype, NTM E258 paratype); **G**, *Didemnum albopunctatum* (NTM E249); **H**, *Didemnum aratore* (NTM E256 holotype).

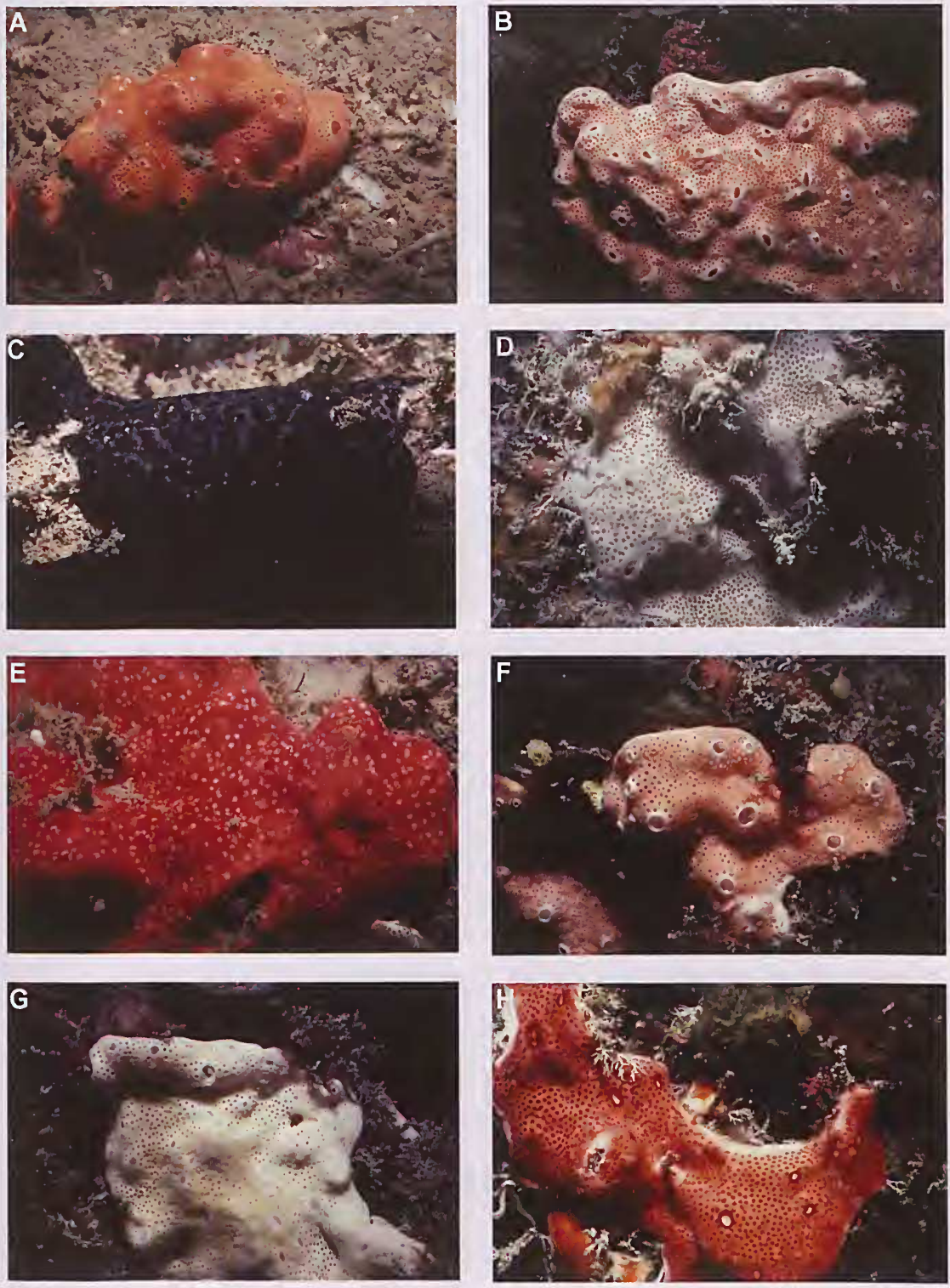

Fig. 23. **A**, *Didemnum clavum* (NTM E296); **B**, *Didemnum domesticum* (NTM E237 holotype); **C**, *Didemnum jedanense* (NTM E295); **D**, *Didemnum lillipution* (NTM E250 holotype); **E**, *Didemnum madeleinae* (NTM E293); **F**, **G**, *Didemnum nekozita* (NTM E238, E272); **H**, *Didemnum rota* (NTM E241 holotype).

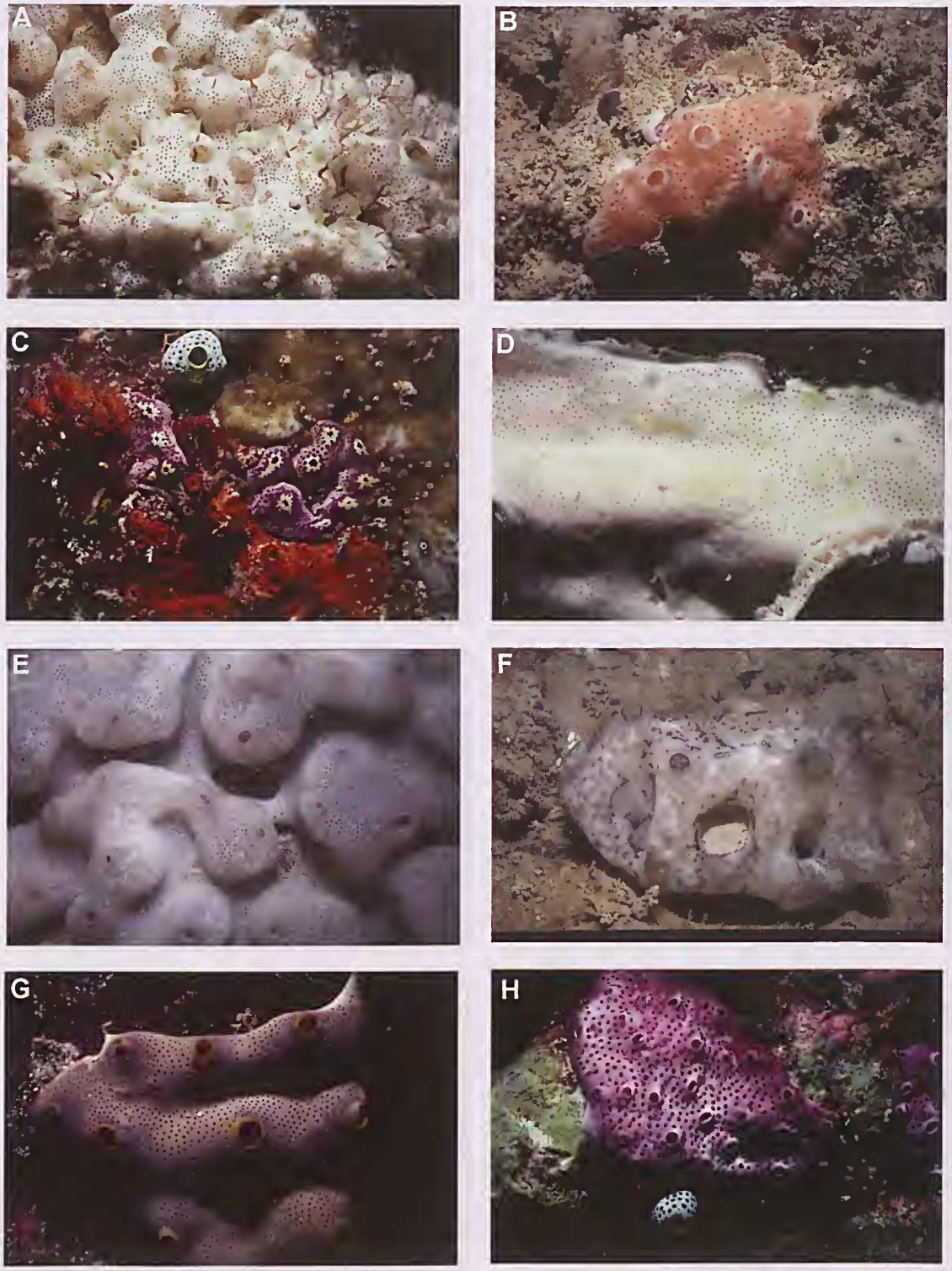

Fig. 24. **A**, *Didemnum tumulatum* (NTM E279 holotype); **B**, *Didemnum usitatum* (NTM E259 holotype); **C**, *Didemnum vesperi* (NTM E239 syntype); **D**, *Tridemnum farrago* (NTM E253 holotype); **E**, *Tridemnum marmoratum* (NTM E294); **F**, *Tridemnum pseudodiplosoma* (NTM E298); **G**, *Lissoclinum badium* (NTM E268); **H**, *Lissoclinum reginum* (NTM E240).

Fig. 25. A, *Lissoclinum taratara* (NTM E290); **B**, *Diplosoma translucidum* (NTM E292); **C**, **D**, *Diplosoma versicolor* (NTM E363, QM G308697); **E**, *Symplegma bahraini* (NTM E284); **F**, *Symplegma brakenhielmi* (NTM E281); **G**, **H**, *Symplegma rubra* (NTM E245, E288).

TAXONOMIC INDEX

Bold and italic numerals indicate respectively species illustrations and the formal description of a new species.